Mariners Weather Log

Winter 1990

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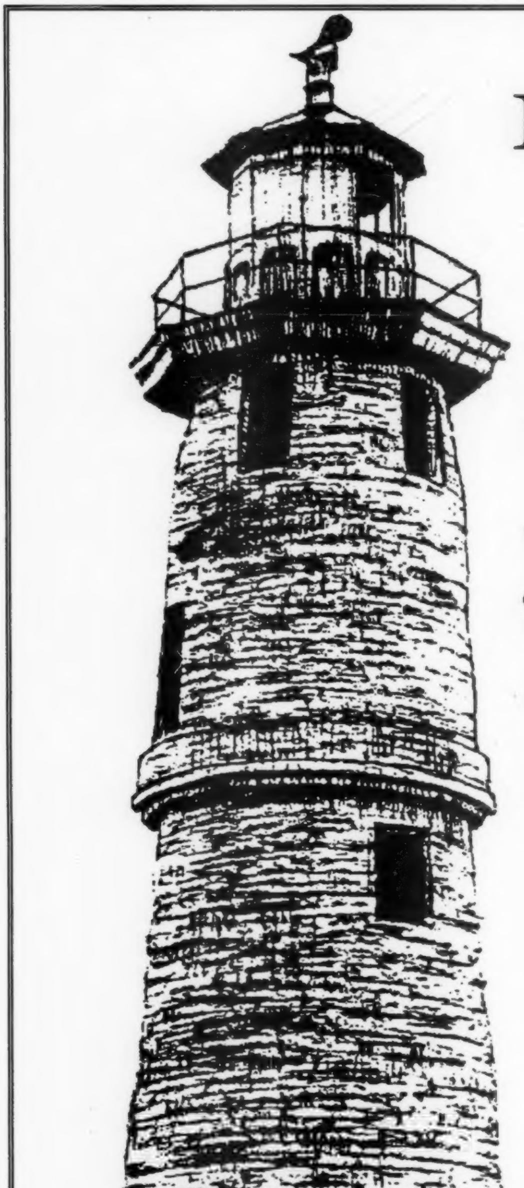


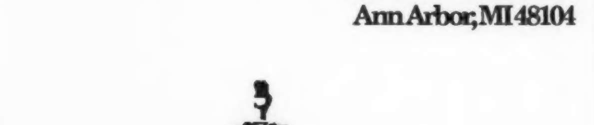
Thames River Rear Range Light

Lake St. Clair, Ontario

Pen and ink drawing by Leo Kuschel
Descriptive passage by Sue Kuschel

The front light in this range system is a white steel, 22–foot, circular tower, built in 1965, but first established in 1837. The rear light, pictured here, dates back to 1845. This light is 55 feet above water and the lantern is red with a unique Canadian ventilating ball. The interior walls of the rear light are white, yellow and red cut stones. Outside, the tower has been painted white for most of its existence. There was a time about 12 years ago, however, when the tower was bare of paint and its interesting brick color pattern could be seen. This light is open to the public. It has wooden circular stairs on the first levels; the top two levels have very straight and angular ladder–type stairs. The caretaker lives in the keeper's house in the back of the light. Most of the interior wood is cedar and the aroma is rather pungent. The first light built here was constructed with wood by the Cartier family. It burned during the War of 1812. The Cartiers served as keepers of this light for 150 years. This light is under the care of the Lower Thames Valley Conservation Authority. This material was kindly furnished by:

Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104



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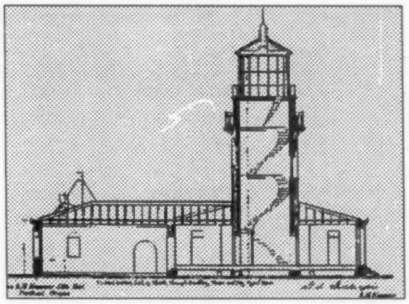
January, February and March 1990

Features



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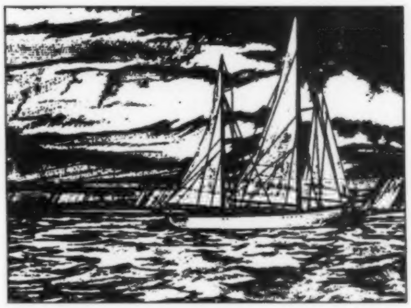

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Departments

Marine Weather Review

Cover: The U.S. Coast Guard International Ice Patrol is part of the overall protection provided to maritime interests by NOAA, the U.S. Navy and the U.S. Coast Guard. Here an HC–130 patrols the North Atlantic ice fields (page 2).

Back Cover: The 200th anniversary celebration of the U.S. Coast Guard continues. The Eagle is one of four vessels, we will feature, that served in the U.S. Revenue Cutter Service, the predecessor of the U.S. Coast Guard. The drawings are based upon the research of the famous historian Howard I. Chapelle.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July 1, 1991.

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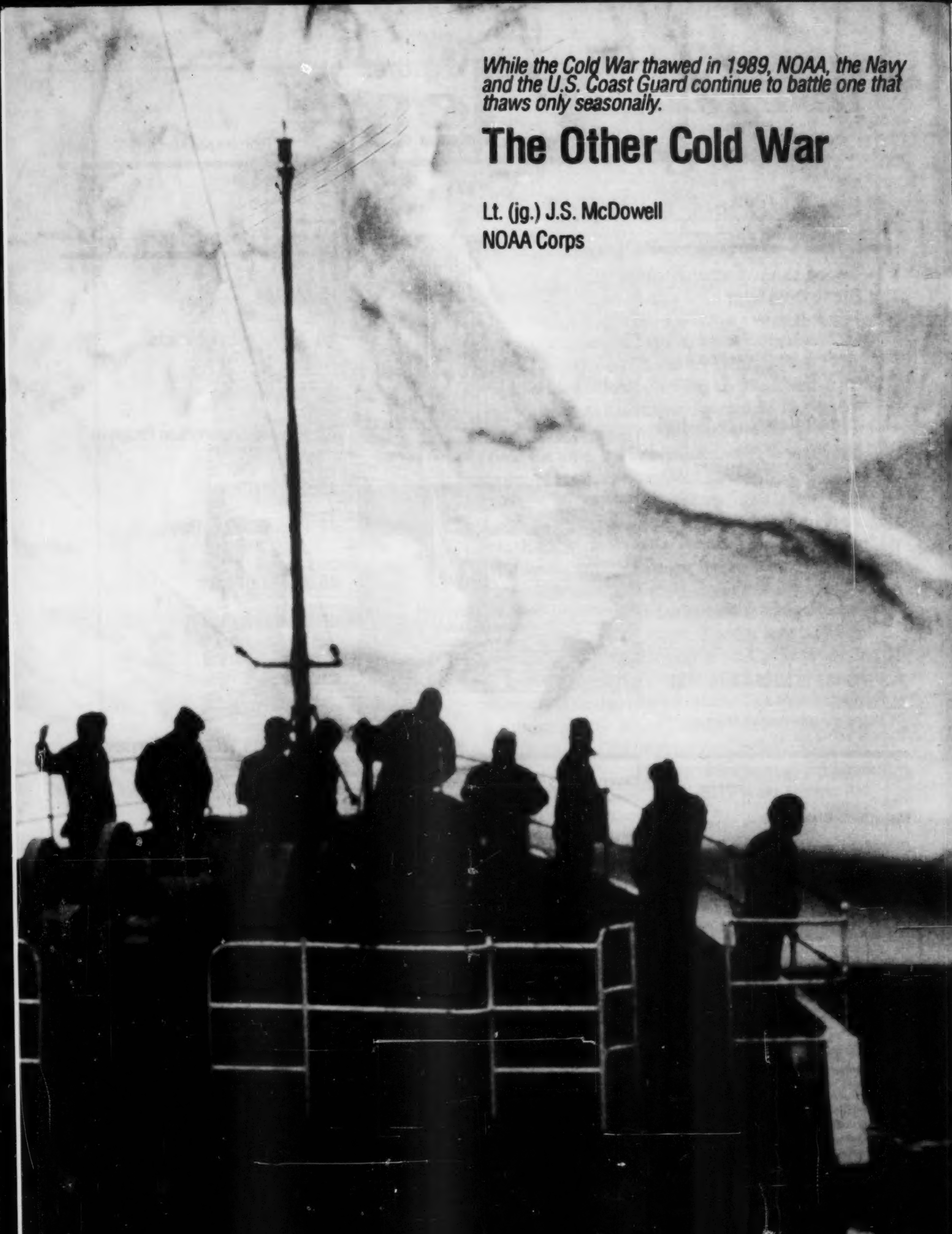
While the Cold War thawed in 1989, NOAA, the Navy and the U.S. Coast Guard continue to battle one that thaws only seasonally.

The Other Cold War

Lt. (jg.) J.S. McDowell
NOAA Corps



In 1951 a secret armada of U.S. supply ships, known as **Operation Bluejay**, steamed north through the icy Arctic waters along the west coast of Greenland. Although the political Cold War was blowing at gale force, the convoy's biggest enemy was not the Soviets but sea ice. Despite all the meticulous planning, the merciless grip of the Arctic pack ice damaged 30 of the 33 ships. One ship, the ***USNS Sappa Creek***, almost sank after striking a massive, unyielding iceberg that tore away most of her metal plated bow.

The damage was so extensive that the ship had to spend months in drydock for repairs. The hard cold steel hulls of the ships were no match for either the sea ice (frozen solid salt water) or the deadly icebergs (compressed glacial ice). The cargo ships were loaded with building supplies needed to establish a permanent early-warning Air Base at Thule station in northern Greenland.

Timing was critical; the task force of ships had to steam in and out of the Arctic waters during the short summer period when the sea would briefly loosen its icy grip and allow ships to slip through the floating frozen fingers of potential disaster. Having accurate knowledge about the sea ice was paramount to the success of the mission, but what was known was not enough.

"We've come a long way" says Bill Dean of Sea Ice Consultants Inc. Mr. Dean was one of the first Air Crewmen involved in trying to map the ice for **Operation Bluejay**. "When I first started in this business we even took ice observations from blimps. Since nothing was known about sea ice, we had to teach ourselves as we went along."

Ice forecasting was critical for supply missions to the early-warning Air Base at Thule, Greenland (below). Vessels had to get in and out of the Arctic waters during the short summer season. At left the ***USS Casa Grande*** *and* ***USS Rushmore*** *were escorted from Thule on the 7th of July 1958. Thule, Greenland was selected as an early-warning site back in the 1950's. North Star Bay forms a harbor the whole of which is part of a N.A.T.O. Defense Area. On the south side there are port facilities for supply of the N.A.T.O. Air Base, which is situated about 1 mile southeast of the port. In 1954, it was established that the bay would be open to navigation from the 20th of July to the 30th of September with an allowable extension of 15 days from the latter date.*

U.S. Navy

*Pack ice can grind away at itself causing the ice floes to ride over one another forming mammoth ridges on top of the pack ice. These ridges have roots which extend deeply into the water under the ice. These extensions under the ice are known as ice keels, and can be followed to a depth of 200 feet. The icy formations at left were photographed during one of the first pictoral explorations of the underside of an arctic ice pressure ridge. The photograph was taken aboard the submarine **Seadragon** by Lt. G.M. Brewer, head of the underwater photography team from the U.S. Naval Photographic Center.*

It was learned that the arctic pack ice floated over the polar region and rotated in a clockwise fashion grinding away at anything in its path like a giant millstone. The pack even ground away at itself causing the ice floes to ride over one another forming mammoth ridges on top of the pack ice. It was also discovered that these ridges had roots, which extended deeply into the water under the ice. These extensions under the ice were known as ice keels, and could be followed to a depth of 200 feet. Because of these underwater obstacles the sub-surface fleet as well as the surface fleet were among those needing reliable sea ice information. Without accurate data the U.S. submarine ***Nautilus*** could not have made her historic voyage under the ice pack to the North Pole. This trip found new dangers. The shifting of the pack ice made a constantly changing underwater maze. To navigate safely the ***Nautilus*** had to weave in and out to avoid being trapped in the tendrils of the ice like a fish caught in the poison stingers of a Portuguese Man of War. Three years later, in 1961, another sub, the USS *Sargo*, actually collided with one of these saber–like ice keels and nearly tore off the superstructure known as the sail. Walt Wittman, of the Naval Oceanographic Office, was on board during the collision "The sound of twisting metal was terrifying." He added "When we surfaced it looked as if some giant of the deep had tried to tear the sail off."

Our warm–water Navy was not adept at sailing in such harsh conditions, but the front lines of the political Cold War were in the Arctic. The Navy's only choice was to learn. In 1952 the Naval Oceanographic Office was given the task of developing an accurate method of forecasting sea ice conditions. Twenty years of study and research of sea ice produced volumes of data. Everything— from the

*While the **Nautilus** was the first submarine under the North Pole, the nuclear submarine **USS Seadragon** became the first ship to negoiate the Perry Channel through the Canadian Archipelago. The **Seadragon** left Portsmouth, NH on the 1st of August 1960 and went up the Greenland–Labrador slot through the Davis Strait and Baffin Bay. She entered Perry Channel on the 15th of August at Lancaster Sound, proceeded through Melville Sound and McClure Strait to complete passage on August 21st. Once through the Archipelago, the **Seadragon** continued northward to the Pole and then on to Honolulu, HI. During her polar transit the **Seadragon** performed a first by going under this iceberg in Baffin Bay.*

U.S. Navy

U.S. Coast Guard

*Ice research was extended to the Antarctic in 1955 with **Operation Deep Freeze**. The U.S. Coast Guard icebreaker **USCGC Glacier** opened channels through ice-paved McMurdo Sound for Navy cargo ships to reach the main scientific base at Hut Point. The **Glacier**, which served on every **Operation Deep Freeze** since the beginning, is seen here in July 1973 passing Mt Erebus. The formerly white 310-foot icebreaker was painted red for easy spotting in the ice by the ship's reconnaissance helicopter.*

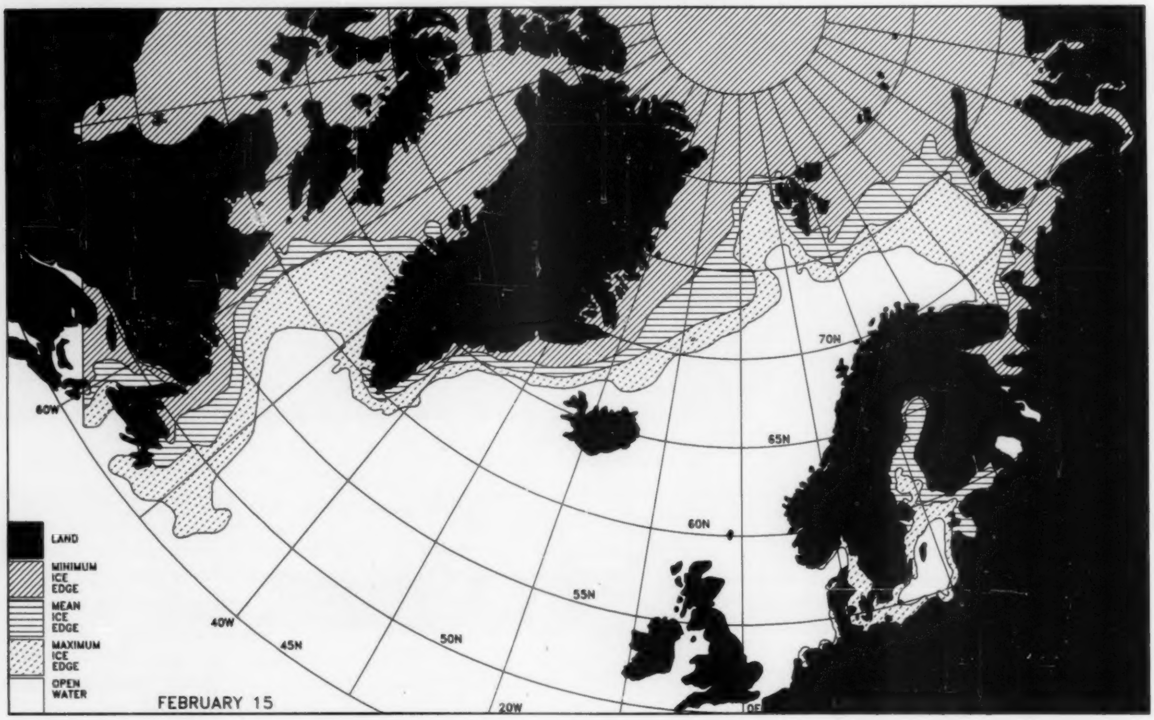
strength of ice to how fast it could form— was studied and tested. Getting data to the fleet quickly was the job of an operational office, not one dedicated to research. In 1972 the decision was made to turn over the responsibility for supporting ships in the Polar regions to the Fleet Weather Facility, Suitland, MD, now known as the Naval Polar Oceanography Center. The demand for the ice data grew quickly. To ease the crush of requests the Navy combined resources with the National Oceanic and Atmospheric Administration (NOAA). In 1976 they formed the Navy/NOAA Joint Ice Center— the only facility of its kind in the world.

Operational forecasting of sea ice movement can be a life and death matter for a ship working in the Polar regions. An area of open water can be locked up with ice in a matter of hours just by a sudden wind shift. As pressure from the ice squeezes in on the steel hull of a trapped ship, it can be crushed like a tin can, and swallowed whole as if by some mythical sea monster. At the frigid temperatures found in the Arctic and Antarctic, sea ice can be stronger than steel and cut through a vessel like a knife through butter.

"Let me give you an idea just how strong the ice, is" offered Captain Tom Callaham, the commanding officer of the Polar Center. "The *USS Iowa* was steaming in the East Greenland Sea and came upon an iceberg. The ship fired her 16-inch guns; and the berg did not even appear damaged."

Though the political Cold War has thawed, the geopolitics of today focus once again on the Poles. This time, however, the emphasis is on the South Pole. In 1991 the current Antarctic treaty expires. At present multi-national negotiations are continuing, but there is as of yet no replacement treaty. Each year more and more research vessels sail through the

MAXIMUM – MEAN – MINIMUM ICE EDGES



stormy, icy waters to Antarctica to study the unspoiled environment or to survey its vast wealth of untapped natural resources, which are protected under the present treaty.

To support so many ships in both Polar regions would be an overwhelming task except for the advent of a vast computer network that links computers from coast to coast. Through this network the Polar Center receives weather and ice reports from one end of the globe to the other. This data is tailored for support of ships working in the pack ice and is available upon the request of the vessel's captain. Even the most seasoned skipper will request all the help he can get when navigating through the frigid waters of the polar regions.

"The key is to find the path of least resistance for the ship to follow" says Rich Cianflone, one of the forecasters at the Polar Center. "Rarely is the course a straight line when navigating through sea ice."

To enable a ship to operate safely in the high latitudes the ice must be mapped. In accomplishing this task, analysts and forecasters use a combination of computer models and digitally enhanced satellite images to distinguish between the different types of ice making up the ice edge and inter–pack concentrations. Once all the data are blended together they result in an ice chart covering both Northern and Southern Hemispheres.

Polar orbiting NOAA satellites now give full coverage of ice conditions for the Arctic and the Antarctic. These satellites complete a revolution around the earth once every 110 minutes making it possible, for the first time, to gather accurate high resolution satellite imagery of the poles. These highly detailed pictures from space make it possible to provide timely sea ice analyses and forecasts for both regions. The Polar Center not only provides reliable ice edge information but can track super icebergs adrift in Antarctic waters. The size of some of these bergs rivals the area of some countries.

Prior to satellites, ice information came from random ship reports and aerial reconnaissance. At best these methods painted a sketchy picture. Throughout history, weather reports of the Polar regions have been so scarce that little was known about the seasonal changes of the pack ice. The sparse data that were available were more fiction than fact.

Don Barnett, the technical director at the Polar Center, feels that the greatest asset available to a forecaster is the nearly 20 years of satellite derived climatological data the Polar Center has compiled. "We now have enough information to give us an idea of what to expect from season to season." He adds "Its like the inscription on the archives building, 'what is past is prologue'."

The Manhattan made a second trip through the Northwest Passage in April 1970. Bogged down in Baffin Bay (left) she was assisted by the Canadian icebreaker, Louis S. St. Laurent. The ridge that stopped the Manhattan was part of a 10–mile diameter ice floe.

Beginning in 1973 all–weather microwave satellite imagery has allowed the routine mapping of Arctic sea ice on a global scale. These data were used in the production of the Sea Ice Climatic Atlas series. At left is an example from the eastern Arctic — Maximum, Mean, and Minimum Ice Edges for mid February. Several other summaries are also contained in these atlases, including the percent probability of occurrence of any ice, and a time series of weekly total coverage and extent. (Courtesy, National Climatic Data Center.)

The U.S. Coast Guard icebreaker Polar Star has a spacious bridge (right). It is an indication of the ship's 83–foot width, which allows it to cut a wide channel for supply ships through the polar ice.

U.S. Coast Guard

The climatological data were used in the mid 1980s to produce a three–part series entitled the *Sea Ice Climatic Atlas*. They were subdivided into the eastern and western Arctic and the Antarctic. These atlases are counterparts of a Sea Ice Digitization Progrm initiated by the Navy/NOAA Joint Ice Center.

Today the Polar Centers' charts are used worldwide by environmental scientists who believe that the first signs of the greenhouse effect will be apparent in the Polar regions. Knowing the boundaries of the ice edge can provide some of the clues needed to help understand this phenomenon.

State–of–the–art technology enables the Polar Center to telefax ice charts via satellite to ships at sea so they have the latest information available. Crab fishermen and ships' Captains alike welcome the information. Crab fishermen in the Bering Sea use the charts to seek out the ice edge, where crabs tend to be more abundant. Conversely, ships' captains need the charts to avoid the ice and find the shortest route around it.

To find the shortcut around North America known as the Northwest Passage has long been a dream of mariners. This treacherous route has claimed the lives of more than one ship's crew. The Passage was first successfully navigated by the SS ***Manhattan*** in 1969, the same year man first landed on the moon. For the past 2 years the Polar Center has helped guide the U.S. Coast Guard ice breaker ***Polar Star*** north of Canada's Yukon Territory through the twisting water way that makes up the Passage. Such voyages would have been impossible without the advance in technology and better understanding of the polar regions provided by the Polar Center . Unlike **Operation Bluejay** ships are no longer heading into the unknown when they sail into the polar pack ice.

The International Ice Patrol

the battle continues

Lt. (jg.) Michael B. Christian
USCG

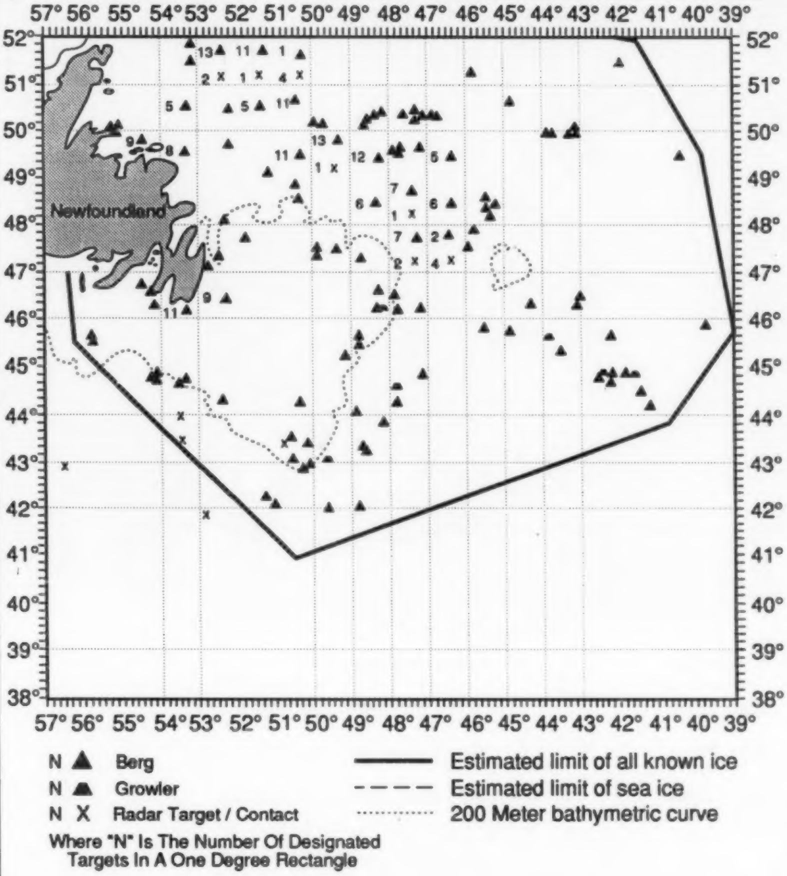
The International Ice Patrol (IIP) **depends** on cooperation and assistance from international North Atlantic shipping in its efforts to warn the mariner of the ice danger around the southwestern, southern, and southeastern extent of the Grand Banks. Each year, over 50% of all iceberg sighting reports come from sources other than IIP reconnaissance flights. **International shipping is the leading contributor of iceberg sighting reports.** During the 1989 IIP year (October 1988–September 1989) 397 different ships representing 40 different flags made 1032 iceberg sighting reports and 376 sea surface temperature reports. The IIP is grateful to those ships.

All ships in the vicinity of the Grand Banks are requested to report ice conditions to the IIP operations center in Groton, Connecticut every 6 hours. The following information is requested:

- ship name and call sign
- position of vessel or ice (specify which)
- course and speed of vessel
- time of sighting
- sighting method (visual or radar)
- size and shape of iceberg
- concentration of ice (for sea ice, in tenths)
- thickness of ice (for sea ice, in feet or meters)
- sea surface temperature.

Negative ice reports arealso requested. Ships in the vicinity of the Grand Banks and observing no ice should report all applicable information and state "no ice observed". To report sightings, send them through either a U. S. Coast Guard Communication Station or a Canadian Coast Guard Marine Radio Station.

Size						Type	
Descriptive Name		Height		Length		Shape	Description
		(ft)	(m)	(ft)	(m)	Non–Tabular	**(N)** This category covers all non tabular-shaped icebergs as described below; includes dome-shaped, sloping, blocky and pinnacle.
Growler	(G)	<17	<5	<50	<15		
Small Berg	(S)	17–50	5–15	50–200	15–60		
Medium Berg	(M)	51–150	16–45	201–400	61–122		**(T)** Flat topped icebergs with length–height ratio > (greater than) 5:1.
Large Berg	(L)	151–240	46–75	471–670	123–213	Tabular	
Very Large Berg	(V)	>240	>75	>670	>213		



During each ice season, generally from March through August, IIP uses long and medium range aircraft to detect and identify icebergs. An all–weather, side–looking, imaging radar helps the IIP find small icebergs and even growlers in poor visibility. IIP aircraft normally fly 7 day patrols out of St. John's, Newfoundland. Aircraft are staged out of St. John's every other week during the course of the ice season.

Ice information collected by IIP is input twice daily into a computer model at the operations center. Ocean current and environmental data are included. The model predicts the drift and deterioration of icebergs. Every 12 hours, predicted iceberg positions are used to estimate the limits of all known ice. This limit and critical iceberg information is then broadcast as an Ice Bulletin from radio stations in the U.S., Canada, and Europe for all mariners. A radiofacsimile chart of the area, depicting ice locations, is broadcast once each day (left).

All mariners are encouraged to report ice because of the extremely hazardous conditions in the Grand Banks region. Approximately 10,000 to 15,000 icebergs are calved from West Greenland glaciers each year, and a small percentage are carried south by the Labrador Current to the Northwest Atlantic. Icebergs are common around the Grand Banks and frequently travel as far south as 42°N before melting in the warm Gulf Stream.

In addition to the iceberg hazard, this region is covered by fog 40–50% of the year because of differences in sea water temperature of up to 20°C where the Labrador Current and Gulf Stream meet. Thus ice, fog, and frequent storms make the Northwest Atlantic one of the most dangerous regions for mariners. It is ironic that these environmental dangers occur in an area congested with vessels due to the great circle shipping lanes and the rich fishing grounds of the Grand Banks.

Iceberg Reports for 1989

	GROWLER	SMALL TABULAR	SMALL PINNACLE	MEDIUM TABULAR	MEDIUM PINNACLE	LARGE TABULAR	LARGE PINNACLE	RADAR	TOTALS	% TOTAL
COAST GUARD SLAR	31	144	55	149	66	84	45	80	654	21.90%
COAST GUARD VISUAL	46	159	43	197	37	75	30	3	590	19.76%
CANADIAN SLAR	5	19	3	21	5	3	1	7	64	2.14%
CANADIAN VISUAL	18	70	25	44	9	19	3	1	189	6.33%
OIL AIR RECON	47	101	9	66	18	25	3	0	269	9.01%
SHIP REPORTS	74	122	91	198	185	83	94	26	873	29.24%
LIGHTHOUSE/SHORE	0	1	3	6	7	6	4	0	27	0.90%
DOD	0	61	1	116	6	55	11	6	256	8.57%
OTHER	4	5	10	17	9	9	5	5	64	2.14%
TOTALS:	225	682	240	814	342	359	196	128	2986	100.00%

INTERNATIONAL ICE PATROL BROADCASTS

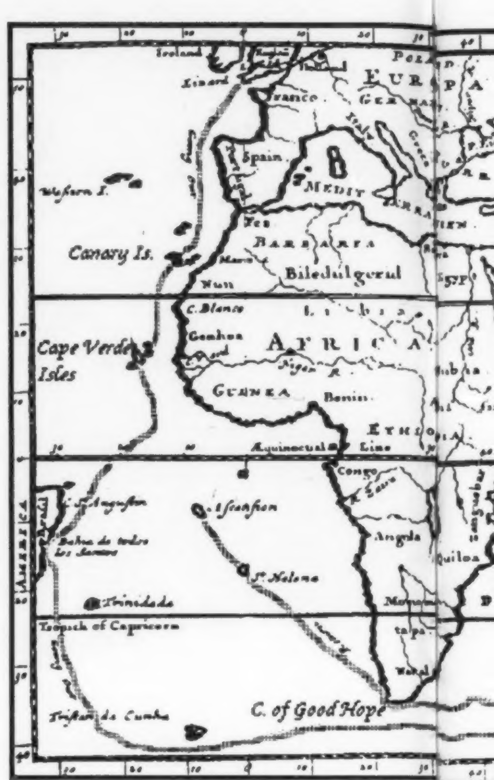
BROADCAST STATION	TIME OF BROADCAST	FREQUENCIES (kHz)
NAVTEX Ice Broadcast C.G. Comm. Stn Boston/*NIK*	0445, 1045 1645, 2245	518
NBDP (FEC) Ice Broadcast C.G. Comm. Stn. Boston/*NIK*	0018 1218	5320, 8502, 12750, 85502, 12750
CW Broadcasts C.G. Comm. Stn. Boston/*NIK* (follows NBDP Broadcast)	0050 1250	5320, 8502, 12750 8502, 12750
Canadian CG Radio Stn. St. John's/*VON*	0000 1400	478
Canadian Forces METOC Centre Halifax/*CFH*	0015, 1101 1301, 1401 2201, 2301 (2230, 2239 if available)	122.5 (off air 1200-1600 2nd Thurs. each month) 4271 Cont., 6330 Cont. 10536 Cont., 1000-2200 UTC
LCMP Broadcast Norfolk, VA *NMN/NAM/NAR/NRK/AOK/* *GXH/NGR*	0800-0900, 1500-1600 1600-1700, 2100-2200	8090 Cont., 12135 Cont. 16180 Cont., 20225 (1200-2359)
Thurso, Scotland/*GXH*	Same Times	7504.5 Cont., 12691 (0800-1900) 4001 (1900-0800)
Keflavik, Iceland/*NRK*	Same Times	5167 (1900-0800)
Key West, Florida/*NAR*	Same Times	5870 Cont., 2675 (1200-2359)
Rota, Spain/*AOK*	Same Times	5917.5 Cont., 7705 Cont.
Nea Makri, Greece/*NGR*	Same Times	4623 Cont., 13372.5 (0800-1900)
Radiofacsimile Broadcasts C.G. Comm. Stn. Boston/*NIK*	1600	8502, 12750(+/- 400 Hz)
Can. Forces METOC Cen. Halifax/*CFH* (Primarily sea ice in Gulf of St. Lawrence and north. Iceberg limits sometimes given)	0014, 1101 1301, 1401 2201, 2301	122.5 Cont., (off air 1200-1600 2nd Thur. each month) 4271 Cont. 6330 Cont., 10536 Cont., 13510 Cont.
Radio Stn. Bracknell, U.K./*GFE* (Eastern N. Atlc Sea Ice Obs.)	1413	2618.5 (1800-0600, Oct. 1-Mar 31: 1900-0500, Apr 1-Sep 30) 4782 Cont., 6330 Cont., 10536 Cont., 13510 Cont.
Special Broadcasts Can C.G. Radio Stn. St. John's/*VON*	As requred when icebergs sighted outside ice limits between sched. broadcasts.	2598 Radiotelephone preceeded by Int. Safety Signal (SECURITE) on 2182 kHz. 478(CW)-preceeded by Int. Safety Signal (TTT) on 500 kHz.
C.G. Comm. Stn. Boston/*NIK*	As requred when icebergs sighted between sched. broadcasts. NAVTEX upon receipt of first available window. NBDP (FEC) next sched. broadcast.	472(CW)-preceeded by Int. Safety Signal (TTT) on 500 kHz.
International Ice Patrol Vessel *NIDK* (when assigned)	When in the vicinity of ice in periods of darkness or fog.	2670 preceeded by Int. Safety Signal (SECURITE) on 2182 kHz.

Perhaps the original volunteer marine observer, Dampier is better known today as:

The Pirate Scientist

Mark Cherrington

Earthwatch

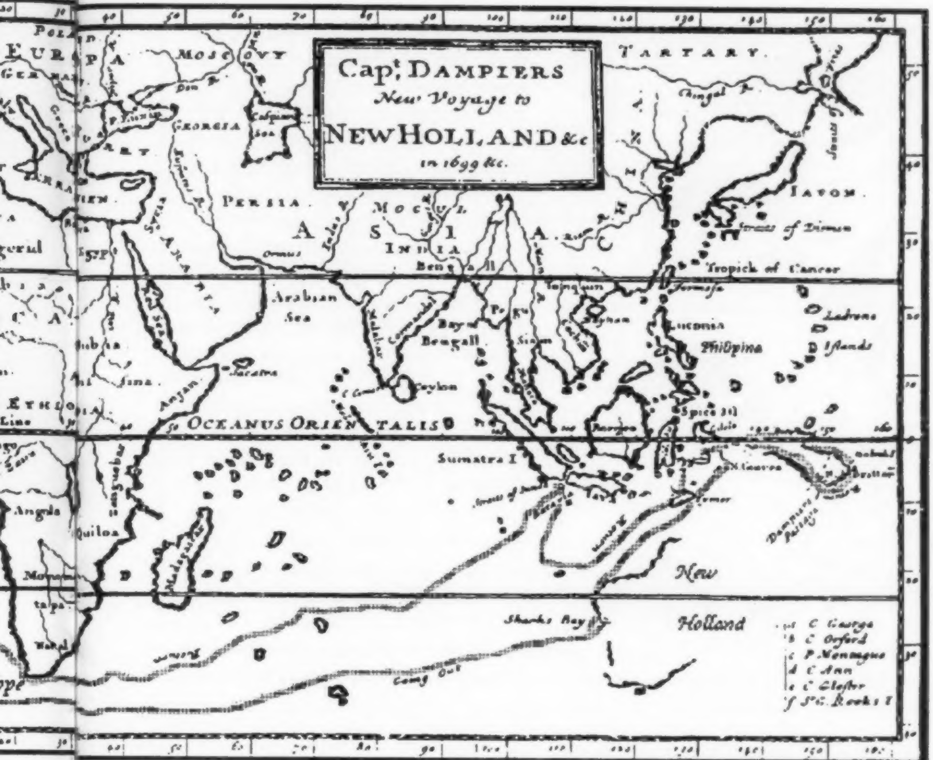


The chances are you have never heard of Will Dampier. His is not exactly a household name. But there could hardly be a person who has left a more indelible impression on history than this 17th-century English explorer. Samuel Coleridge modeled *The Ancient Mariner* after Dampier; Jonathan Swift, in his book *Gulliver's Travels*, made his fictional traveler a cousin to Dampier; and Daniel Defoe was inspired to write *Robinson Crusoe* after reading Dampier's story. And those are just the literary references.

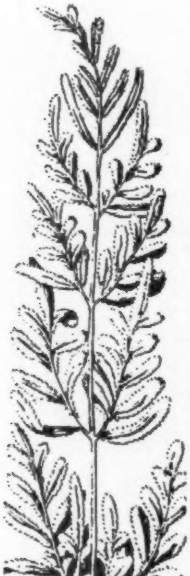
He circumnavigated the globe three times in a period when only a handful of men had done it once (Magellan died in his attempt). He discovered the straits between New Guinea and New Britain, compiled the first wind charts for the Pacific Ocean, was the first European to describe a typhoon, was the first Englishman to land in Australia, and brought back the first popular descriptions of such now-commonplace things as coconuts, bananas, limes and cashews. In fact, it was his description of breadfruit, on the island of Guam, that prompted Captain Bligh's ill-fated trip on the *H.M.S. Bounty*.

William Dampier

So why isn't his name as famous as Cook's or Drake's? Probably because Will Dampier sailed for reasons very different from his contemporaries. At the time Dampier began his rovings, in 1679, there were essentially three classes of ships on the high seas: naval vessels, privateers, and pirate ships. These three categories were determined by how closely any ship was associated with the government. That is, naval ships were completely governmental and pirate ships were independent of any nation's laws. But in the middle were the privateers, the category under which Dampier made most of his voyages. Their official purpose was discovering new trade outlets and resources, while their unofficial purpose was attacking the ships of their country's enemies. These arrangements let the government keep its hands clean when circumstances were questionable and provided a cheap supplement to the navy. The



Captain William Dampier's voyage to Australia or New Holland as it was known in 1699 is charted on a map of the period. His route to Australia took him by way of Brazil, where he sketched the plants below. In Australia, Timor and New Guniea he made many sketches of plant, animal and fish life some of which are contained on the following pages.



king, by way of payment for this service, would turn a blind eye to the privateers' taking any profit that might be involved.

Predictably, some people viewed privateers as patriotic entrepreneurs, while others considered them pirates by another name. But by any name, these men sailed for personal profit. They did make many discoveries, but these were simply by-products of their financial quest. They did report their findings, but almost always in the form of self-aggrandizing adventures or fabulous exaggerations.

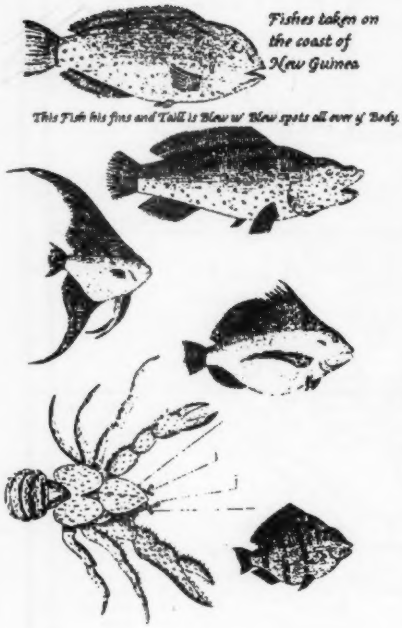
Dampier, however, sailed because he had an insatiable curiosity. He began as a privateer, and certainly took booty and was involved in his share of killings. These were necessary evils— for him privateering was the only way to see the world, but his goal was always to see it rather than to own it. His writing was criticized because it was objective, unadorned, and much more thorough than the usual, while he was doomed to the obscurity of a thinker.

"It has almost always been the Fate of those who have made new Discoveries," he wrote, "to be disesteemed and slightly spoken of, by such as have no true Relish and Value for the Things themselves. But this Satisfaction I am sure of having, that the Things themselves in the Discovery of which I have been imployed, are most worthy of our diligentest Search and Inquiry; being the various and wonderful Works of God in different Parts of the World: And however unfit a Person I may be in other respects to have undertaken this Task, yet at least I have given a faithful Account, and have found some Things undiscovered by any before, and which may at least be some Assistance and Direction to better qualified Persons who shall come after me."

Though Dampier was unappreciated in his own time, we can recognize in him an attitude that's quite

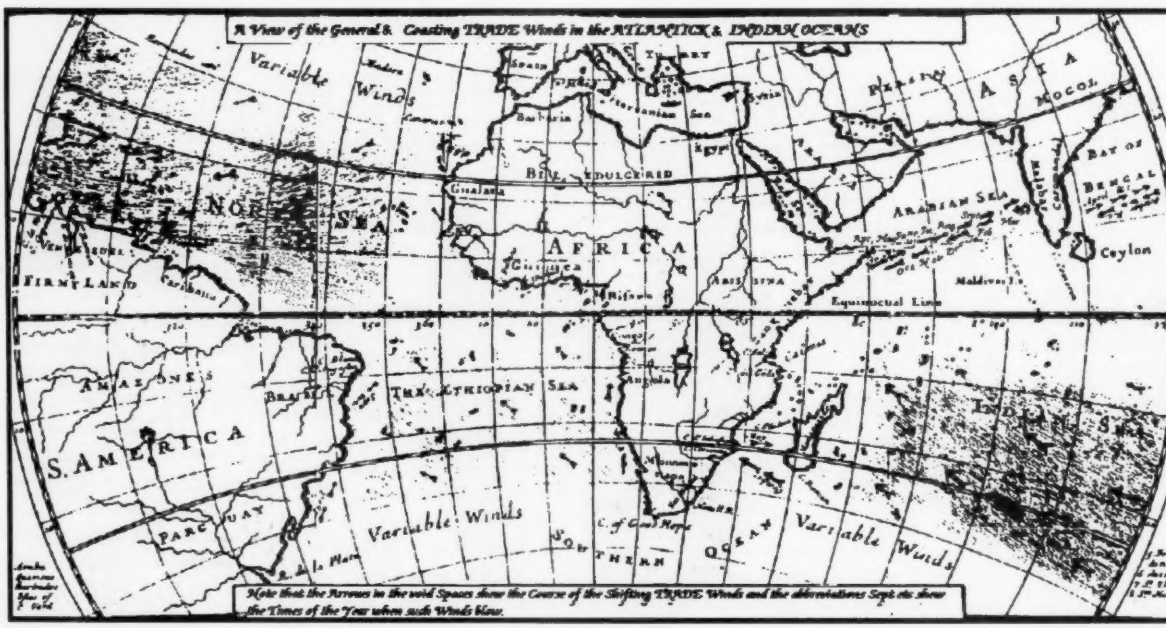
respected today. Dampier was at heart a scientist. Officially, his second voyage to Australia was the first expedition ever to set out with the sole purpose of scientific investigation.

In the course of this voyage, he provided what many believe to be the first description of a kangaroo, charted large sections of Australia's coast, and discovered dozens of species of plants, birds, reptiles, and fish, many of which now carry his name. He brought back to England a substantial botanical collection that still is on display at Oxford, and that includes specimens of Clianthus dampieri and Beaufortia dampieri. The wind charts he produced in 1699 were cited in a 1922 edition of Nature as containing "as much information about the distribution of winds as any of the modern works on the same subject."

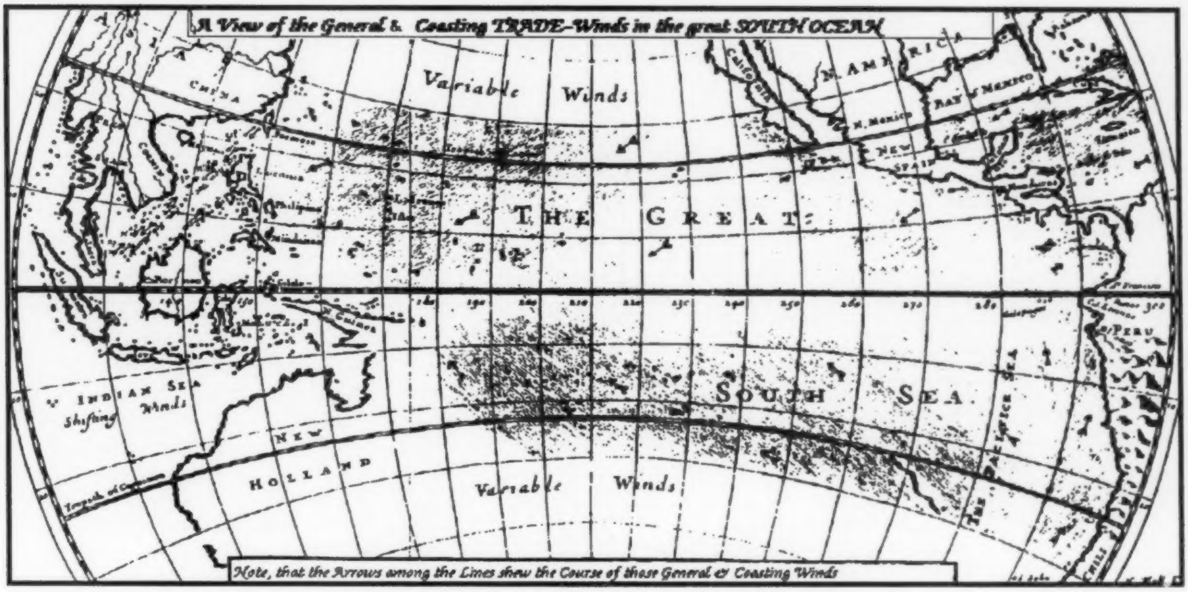


While he was undoubtedly more enlightened than his contemporaries, he was still a product of his time. His descriptions of plants and animals always carried a notation on how they tasted (he seemed to be remarkably flexible in his gustatory preferences). And his anthropological observations were something less than broad-minded. For example, he described the aborigines of Australia as *"the miserablest People in the world. The Hodmadods of Monomatapa, though a nasty People, yet for Wealth are Gentlemen to these...And setting aside their Humane Shape, they differ but little from Brutes."*

It was just such an indelicate attitude that got him into serious trouble in Vietnam during his first circumnavigation. He asked to be put ashore in Malaysia rather than deal with an overbearing captain, and along with several shipmates set in a canoe for Sumatra, 200 miles away, where he hoped to find another ship. Unfortunately, he was sailing during the monsoon, and suffered weeks of tremen-



Dampier was an astute weather observer. This chart of his observation of trade winds in the Atlantic and Indian Ocean was part of his Discourse on Winds which was hailed in a 1922 edition of Nature as containing "as much information about the distribution of winds as any of the modern works on the same subject." Dampier also provided accurate accounts of tropical cyclones at sea a century before any scientific study got underway.



His Great South Sea adventures allowed him to observe: "Though I have never been in any hurricane in the West Indies, yet I have seen the very image of them in the East Indies, and the effects have been the very same; and for my part I know no difference between a hurricane in the West Indies and a tuffon on the coast of China in the East Indies, but only the name. And I am apt to believe that both words have only one signification, which is violent storm."

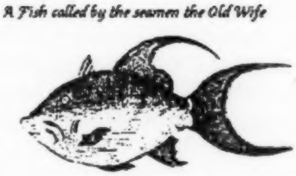
dous storms.

"The Evening of this 18th day was very dismal," he wrote. *"The Sky look'd very black, being covered with dark Clouds, the Wind blew hard, and the Seas ran high. The Sea was already roaring in a white Foam about us; a dark Night coming on, and no Land in sight to shelter us, and our little Ark in danger to be swallowed by every Wave. I had been in many eminent Dangers before now, but the worst of them all was but a Play-game in comparison with this."*

They did make it to Sumatra, thanks to Dampier's remarkable navigation, but the cold wind, drenching, and exhaustion left them seriously ill (all of Dampier's shipmates subsequently died of their fevers). Dampier himself survived, but suffered from recurring fevers and dysentery for almost a year. That, of course, did nothing to slow him down. This was a part of the world Dampier had never seen, so he decided to go traveling to

A Fish of the Tunny kind taken on y Coast of N. Holland

A Fish called by the seamen the Old Wife

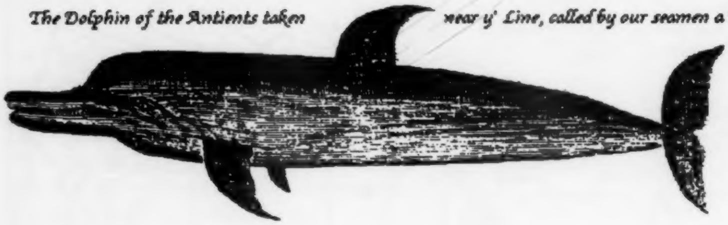


Vietnam. He spent several months sailing along the coast and at one point hiked overland, *"being desirous to see as much of it as I could."*

On the third day's march, he and his guide came upon a crowd at what Dampier took to be a market. There was a large tower in the middle of a square and stalls with food spread around it. He wanted some meat for dinner, but couldn't communicate with his guide, who spoke no English, so he simply went in to negotiate with the man at a meat stall.

"When I saw that there was none of it in small pieces," he wrote, *"I, as was customary in the Markets took hold of a Quarter, and made Signs to the Master of it, as I thought, to cut me a Piece of two or three Pound. I was ignorant of any Ceremony they were about, but the superstitious People soon made me sensible of my Errour: for they assaulted me on all Sides, buffeting me and renting my Cloaths. My Guide did all he could to appease them, and dragged me out of the crowd and we marched away*

The Dolphin of the Antients taken near y' Line, called by our seamen a Porpus



A Dolphin as it is usually called by our seamen taken in the open Sea

as fast as we could. I could not be informed of my Guide what this meant; but sometime after, when I was return'd to our Ship, the Guide's brother, who spoke English, told me, it was a Funeral Feast, and that the tower was the tomb to be burned."

Typically, despite the melee, Dampier managed to note the exact dimensions of the tower and the material of which it was constructed. Even during his terrifying open-boat trip to Sumatra, he noted all the weather patterns, the types of fish and birds they saw, and the ocean currents. He was, in the best tradition of science, an inveterate observer, noting everything, even when he didn't understand what he was looking at, in the hope that someone would someday understand it.

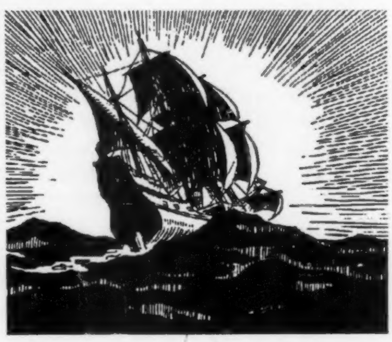
Even through the differences in language and a vastly different approach to field work, we can still appreciate the thoroughness of his description of a Guinea Hen on the Cape Verde Islands, on his way to Australia: *"They are bigger than our Hens, have long Legs, and will run apace. They can fly too, but not far, having large heavy Bodies, and but short Wings and short Tails: As I have generally observed that Birds have seldom long Tails unless such as fly much; in which their Tails are usually serviceable to their turning about, as a Rudder to Ship or Boat. These Birds have thick and strong, yet sharp Bills, pretty long Claws, and short Tails. They feed on the Ground, either on Worms, which they find by tearing open the Earth; or Grasshoppers, which are plentiful here. The Feathers of these Birds are speckled with dark and light Grey; the Spots so regular and uniform, that they look more beautiful than many Birds that are deck'd with gayer Feathers. Their Necks are small and long; their heads also but little. The Cocks have a small rising on their Crowns, like a sort of a Comb. 'Tis of the Colour of a dry Wallnut-shell, and very hard. They have a small red Gill on each side of their Heads, like Ears, strutting out downwards; but the Hens have none."*

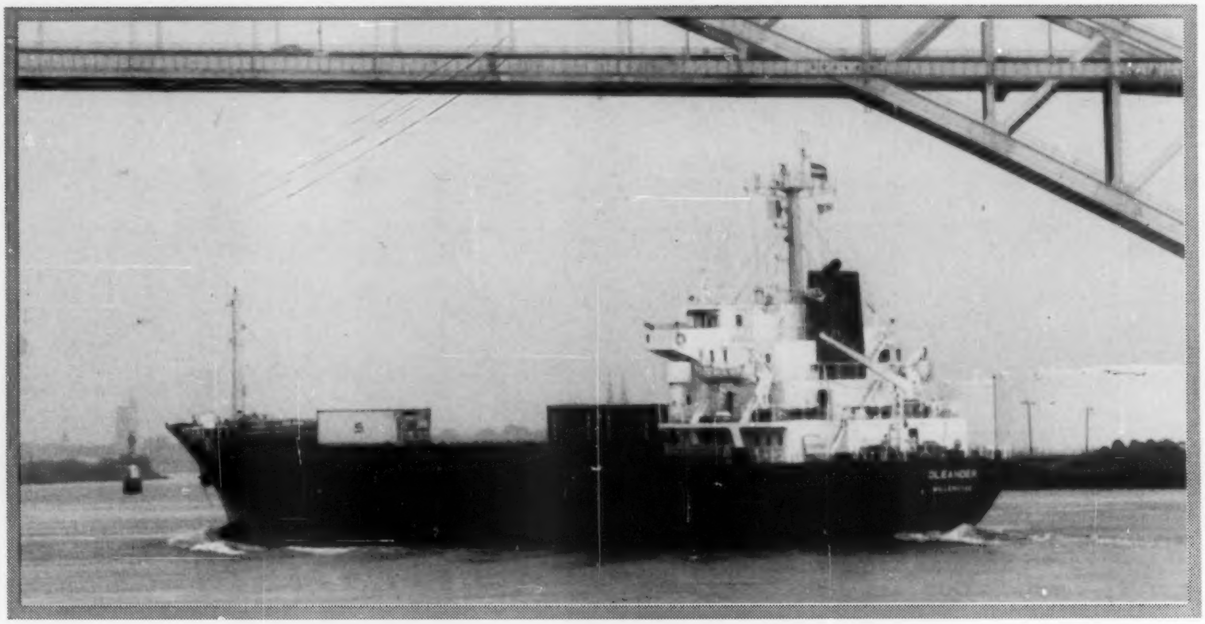
Unfortunately, Dampier's crew did not always share his enthusiasm for science. During his voyage to Australia, for example, when the ship reached Brazil, they refused to go farther, thinking the whole thing a dangerous waste of time. Dampier feared a mutiny. The chief troublemaker was a Lieutenant George Fisher (he was one of those who thought of privateers as pirates, and berated Dampier on this account). In fact, Fisher caused so much trouble that Dampier had him put in jail in Brazil and shipped back to England. But bad luck plagued Dampier even at a distance. Fisher arrived in England 2 years before Dampier returned, and spent that time spreading rumors and lies about Dampier's competence.

By the time Dampier returned from his groundbreaking expedition, a court-martial was already waiting. The court found him guilty of trumped–up charges of cowardice and abusing his men, and refused to allow him to sail on the king's ships.

Dampier did go to sea again on privately funded voyages, but the court-martial had broken his spirit; he stopped keeping a diary and never published anything again, and he started drinking heavily. His troubles weren't over, however. When he returned from his last voyage—the only one in which he made any money, thanks to enemy prizes captured along the way— he became enmeshed in a law suit over the legality of the prizes taken. Because of the suit, he never managed to collect his share of the profits, and died 2,000 pounds in debt in 1715, known only as a buccaneer.

This article appeared in ***Earthwatch*** in April 1989. Earthwatch is a company of scholars and citizens working together to increase public unerstanding of science and to expand our knowledge of the globe and its inhabitants.





Adventures in Data Collecting

Muriel Cole
National Ocean Service

Captain J.J. Vrolyk of the ***Oleander*** is concerned, like most masters, about the quality of marine forecasts: "To make an accurate forecast, the more data the better. On land you have observation stations, at sea you have to rely on ships. The information we give, we get back in better weather forecasts."

The ***Oleander*** and the Bermuda Container Line don't just talk a good game. For the past 5 years they have taken a voluntary data collector, usually a NOAA employee, for 1 week each month on the ***Oleander's*** scheduled weekly run between Newark, NJ and Hamilton, Bermuda. I was one of those volunteers.

The following notes were taken from the diary of a first-time mariner :

Friday, May 12— All at sea

So many containers!! Some with their own refrigerators. All hooked together beneath and on top of the deck of the ***Oleander***. The word container in Dutch must be the same as the English. I sure hear it a lot.

The crew — Six Dutch and six Caribbean, all bi-lingual — are very friendly. Big smiles. At the Newark

*The **Oleander** (left) is a 1500–ton, 300–foot long Dutch container ship operated by the Bermuda Container Lines. At right containers are being loaded onboard the **Oleander** in Newark, NJ. The author (below) launches an expendable bathythermograph (XBT) probe from the hand–held launcher. The observations are entered into the Shipboard Environmental Data Acquisition System (below, right), which formats them properly and transmits them by satellite at the appropriate time. More information on SEAS can be found on page 6.*

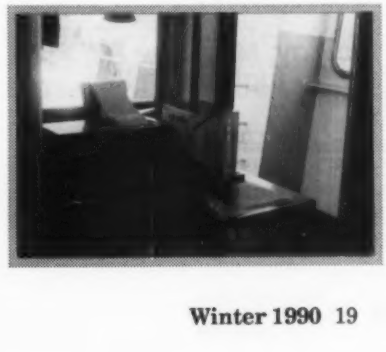
container terminal, where I have been waiting with the ship for 7 hours to depart, a middle–aged career woman is about as common as a giraffe who's somehow wandered into a cow pasture. I am tremendously excited about doing this— *going to sea* to actually take the types of ocean measurements that I've been hearing , reading, and writing about as part of my job as an international affairs specialist with NOAA's National Ocean Service. The kind of ocean measurements— temperature vs. depth and salinity, for example,— that are now recognized as being extremely important to our ability to understand our environment and predict short–term and long–term weather and climate changes.

In addition to taking oceanographic data, the volunteer manages a Continuous Plankton Recorder. This retrieves plankton for scientists studying long–term plankton distribution, abundance and seasonal variations. A continuous set of data, taken in this Mid–Atlantic Bight region, has been collected since 1970, with the ***Oleander*** having been used for this purpose since 1981. Supplies are delivered to the ship at Port Elizabeth, New Jersey, from the NOAA lab in Rhode Island on the ship's arrival and departure. Volunteers are enlisted, trained, and transported to and from Newark. Training is important. Things can go wrong, causing the data to be useless: the equipment can malfunction, or the volunteer can make an inadvertent error. Expendable bathythermographs (XBTs), which the volunteer throws over the side each hour for 18–24 hours, cost $30 each, so those alone are a costly investment.

At first, I am nervous and embarrassed about not knowing how to take the observations; after all, I do work for NOAA. I screw up on the very first XBT toss, wasting it. The Captain assures me that within a few hours I will be a pro, and he is right, sort of. It gets easier, though by about the 20th hour, the term *endurance test* does seem appropriate. The hours become unknown, and the kind smiles and support from the captain and crew become even more appreciated.

Saturday, May 13— Are we having fun yet?

"Is it still fun, or is it wearing a bit thin?" questions the Captain, as I enter the bridge to send a satellite message for the sixteenth hour straight. He or the officer–on–watch graciously provide the latitude and longitude as well as bottom depth, which are included with each data transmission. "Oh, it's still fun," I reply, lying through my teeth. I am mad at myself for making a lot of stupid mistakes, (like entering



A few of the Oleander's Officers and crew, along with the author model the latest in survival suit wear. If this were color, the fashion statement would be complete as one of the year's hottest colors, day-glo orange, was selected to complement the stylish design.

the wrong data from the very beginning on my log sheet!) and I basically feel like a sick oyster at low tide at this point. One of the officers turns on a tape player that plays old rock 'n roll tunes which picks me up a little.

Although I don't finish my observing duties until 5 p.m. the next day, I bottom out about 4 a.m. in my attitude about this odyssey. After 10 hourly rounds of stumbling around in the dark to lower a heavy bucket over the side and hauling cold seawater back in on a totally greasy line, getting covered each time with black gook, I want to come face–to–face with a scientist and scream, "Why don't you collect your own damn data?"

Sunday, May 14— A good night's sleep

I have made a miraculous recovery. It's remarkable how 12 hours of sleep, a hot shower, and clean clothes can improve one's outlook. I no longer feel pathetic, and I no longer look like a total scuzz. I enjoy a great breakfast of junk food brought from home. (After missing the ship's breakfast, I forgot that we had passed some magic line that moves the clocks ahead one hour.) Now that I'm a free woman again, I can play with this laptop computer in my room all day and peer out at the navy blue expanse, with the reassuring hum of the engines in the background. I am thrilled to have done this. When the Captain learned that I am writing something about this experience, he pulled out from a drawer two reports done by other NOAA volunteers. Although I have never heard of these people, I feel like I have shared something really special with them.

David A. West, National Weather Service, Philadelphia, Pa., began his report like this: "The week that I spent on the container vessel ***Oleander*** will be remembered for the rest of my life. My participation in the Ship of Opportunity Program was truly rewarding."... "The trip gave me a great respect for the men who make their living on the high seas, and gave me the opportunity to experience the sea conditions created by differing weather systems." David got to see gale force winds and 15–foot waves, along with the accompanying physical effects. Not a lucky break for him.

Beyond the call of duty

Following my 12 hour rejuvenation period, I reappear at the bridge around 10 a.m. "Oh, just in time for some fun now," the Captain tells me, as he holds up a brand new bright orange survival suit that looks like something from the costume wardrobe on a science fiction movie set.

"A test?" I ask. "Yes, and that includes you too. It will mess up your hair that's the only thing," he replies. He explains that this drill has not been attempted before. So we all, supposedly in groups of six, get lifejackets huge ones with headrests fastened in place, only to realize we've goofed up and

A cruise ship (left) nears its destination of Hamilton, Bermuda— that's how I thought I was going to Bermuda. Oh well, after all was said and done, the beach at Tobacco Bay, Bermuda (below) was certainly compensation.

were supposed to don the survival suits first, followed by the lifejackets. Once suited up, I manage to be able to move around enough to walk the few steps from the lifeboat to my room to grab my camera, which is a big hit, with everyone taking pictures and asking me to send copies back. The suits are really quite clever things, with whistles here and there and Velcro–fastened pockets containing big mittens and rubber zippers and wrist cuffs.

Out on the deck, I think of how amazing it is that 189 containers and 13 people and a ship are out in the middle of the ocean. Other than occasional trash, there is nothing that wasn't here at the dawn of man. Most of the containers, as I peer down on them from the bridge, have bumper stickers on the back with the motto of the Bermuda Container Line— "Follow Me to Bermuda".

I have been reluctant to spend much time with the officers and crew because I've felt (1) conspicuous, (2) exhausted, and (3) self–absorbed. But today I join them for their noontime drink in the Captain's quarters. They ask me what all the NOAA people do in Washington, and I mention lawyers, which gets a laugh and the *Exxon Valdez* oil spill, which is not their favorite topic of conversation. I now feel comfortable enough physically and mentally to actually eat a whole meal with them, instead of just pushing my food around on my plate and looking forward to working so I have an excuse to take my queasy stomach and tired body away from the table.

It's not all work

An off–duty engineer, a lanky Dutchman who reads Stephen King novels, and I spend the afternoon looking for the best spots on the ship to catch some rays. It's beautiful out here. The crew from Barbados is painting orange spots all over the place, supposedly to retard rust, but I think how nicely the ship now matches our survival get–up. This is a color–coordinated place.

In the evening we watch a video movie and afterwards can see Bermuda on the radar, 26 miles away. I had been invited to wander around the ship as I pleased but hadn't. Now we are anchoring for the night, 1 mile off the coast, and I decide to check out the place, startling one of the crew who is cutting up flying fish in his underwear, getting ready to fish— big smile. By midnight most everyone is on the stern in the moonlight dangling bottles, Sprite cans, anything. In they haul little sheepshead, grunts, butterfish, and snappers— the snappers perfectly match the aforementioned decor. With each catch one of the more animated fishermen yells, "It's a whale! It's a whale! Go tell the Captain I need one of those containers for this one!" I take pictures left and right; big smiles.

In the morning we dock and get the immigration and customs clearances to leave the ship. I get off and look for the nearest pay telephone to call home to say I nailed it.

Shipboard Environmental Data Acquisition System (SEAS)

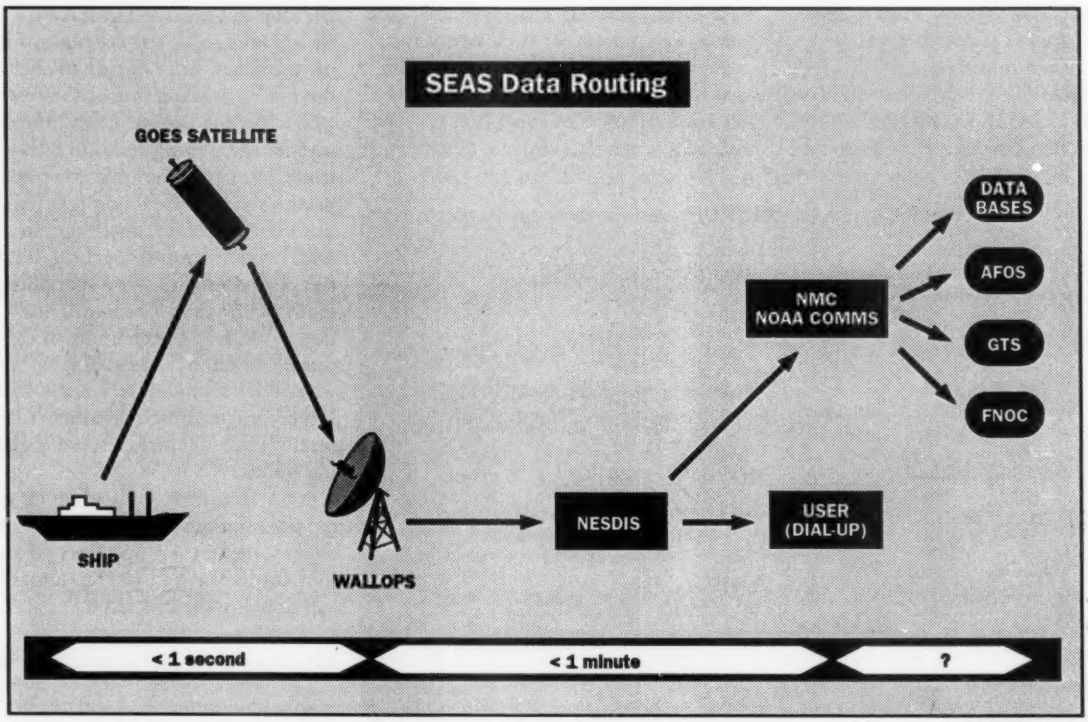
The *Oleander* is one of the many ships of opportunity, in the Voluntary Observing Ship program (VOS), which carry various types of equipment that relay data via radio or satellite as part of the World Weather Watch and the Integrated Global Ocean Services System.

The equipment used is becoming more sophisticated, with a typical Shipboard Environmental Data Acquisition System (SEAS unit) now capable of delivering both marine meteorological and subsurface temperature data quickly via the Geostationary Operational Environmental Satellite (GOES) System. In less than 10 minutes, the data are transmitted to a receiving station at Wallops Island, Virginia, and on to the National Meteorological Center for use in forecast model runs.

Installation of SEAS equipment and instruction of the crew take only a few hours. Once activated, the operator uses a *menu* on the screen of the SEAS microcomputer. Meteorological data are entered manually on the microcomputer's keyboard. The system automatically formats the data into the approved pattern and sends them to the satellite at the predetermined time. Subsurface temperature data, an optional parameter, are collected by using expendable bathythermograph probes (XBTs). The operator holds a small launcher to deploy the probe over the side of the ship to record temperature–depth pairs.

SEAS systems are in operation on 20 ships of opportunity. To insure optimum data coverage, potential ships are evaluated for areas of operation, vessel capability, and vessel interest in the program. The *Oleander*, has been a particularly active partner in the NOAA program, volunteering to collect not only meteorological and oceanographic data but also biological data for NOAA marine fisheries research. For more information about the NOAA VOS program or about SEAS systems, contact:

National Ocean Service, NOAA
N/OS1, Room 103
6001 Executive Blvd.
Rockville, Maryland 20852
Telephone: 301–443–6076



Richard Abram

I just finished reading your article concerning cold weather photography and have a problem with one suggestion. In the past I used to keep my camera inside my coat as you recommended until I learned the moisture the body puts out (even through your clothes) permeates the camera workings and is subject to freezing. By experience I discovered this— my camera shutter would remain open until it thawed!

All the other suggestions you presented are being practiced as I step out on the bridge wing these cold days. My crew and I have spent the last two weeks icebreaking on the St. Mary's River— no photos yet but I hope to have some soon.

Sincerely
Edward Sinclair
U.S. Coast Guard

This is a good point. There is nothing like practical experience. The fact that moisture can be a problem in cold weather as well as warm is something that can be learned from the ventilation problems that occur aboard cargo vessels. In addition cameras can vary in how they react to the cold. I read where some professionals prefer an old Leica M–3 rangefinder to the single lens reflex. The reasoning is that the single lens reflex has a mirror that moves up and down as well as a diaphragm that stops down and reopens. The philosophy is the simpler the better without sacrificing quality.

The moisture problem may also occur if the camera is taken outside and inside with a large change in temperature. One possible solution is to keep the camera in a plastic bag, with as much air squeezed out as possible, along with a bag or canister of silica gel, which absorbs the moisture. I was also reminded that you have to be careful in breathing around your camera in the cold. The warm air from your lungs could fog and freeze on the lens or viewfinder, creating another set of problems.

—ed

Polar Star

In keeping with the winter theme of this column, and the Navy/NOAA Joint Ice Center article on page 2, here is a wonderful Coast Guard photograph of the icebreaker ***Polar Star***. Using people to show the relative size of an object is a well known photographic principle. This shot is an excellent example of that technique, showing the immense size of the icebreaker.

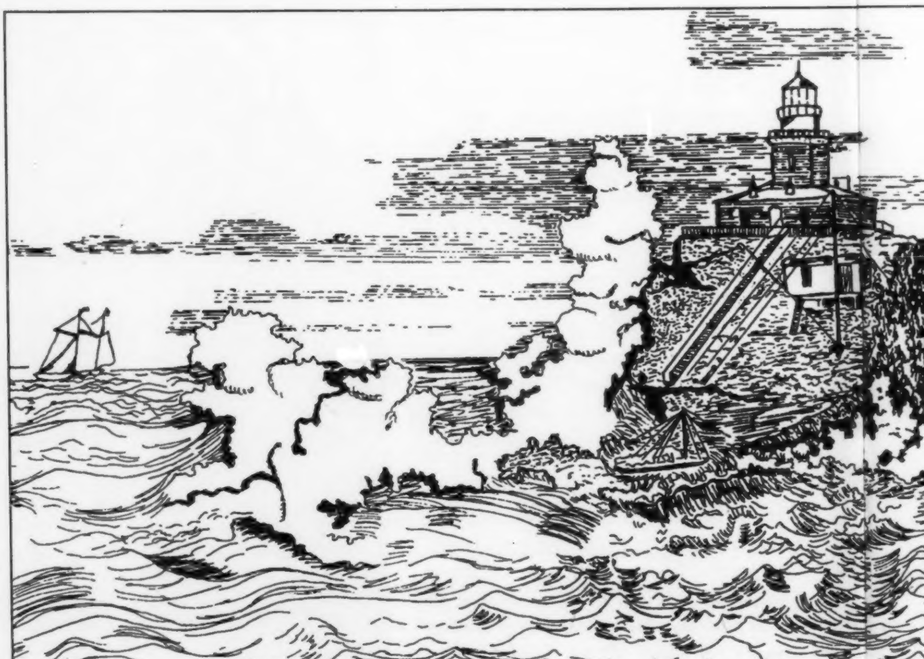
Tillamook Rock Lighthouse

Elinor DeWire
Mystic Seaport Museum
Mystic, CT 06355

About a mile off Oregon's Tillamook Head is a chunk of basaltic rock that protrudes above water like the humped, barnacle–covered back of an ugly sea serpent. This forbidding piece of briny real estate lies some 20 miles south of the treacherous Columbia River Bar. Here, the rushing waters of the river estuary meet the ocean flood tide in a maelstrom of churning, surging sea. Maritime historian James Gibbs estimates more than 2000 shipwrecks have occurred in this area in the past few centuries.

Years ago, the only witnesses to this destruction were the thousands of sea lions that lounge on Tillamook Rock and frolic in the deep, cold waters around it. After 1881 though, a single watchful eye took over the vigil—*Terrible Tillie.*

This is the nickname given Tillamook Rock Lighthouse by its first keepers. The unflattering moniker was



well–deserved, for Tillamook Light was not only a terror to build but many of its lonely keepers likened a tour of duty in it to a prison sentence. Tillamook Rock is among the most desolate and dangerous light stations in the United States and reflects the ever–present struggle between sea and shore along the rugged Pacific Northwest Coast.

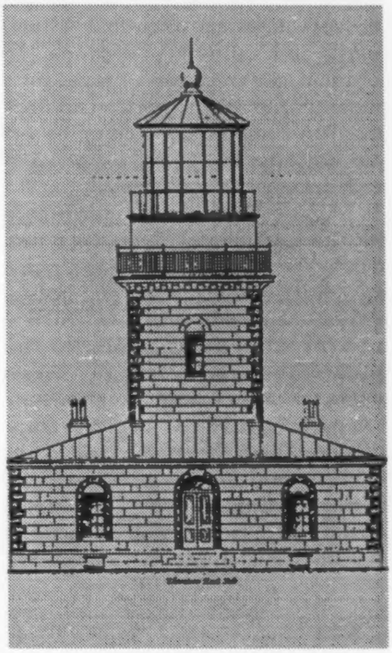
...Tillamook's extreme elevation often left it shrouded in clouds and fog.

The need for a lighthouse at Tillamook was recognized soon after acquisition of the Oregon Territory, but it wasn't until 1878 that decisive action was taken. In that year, Congress appropriated $50,000 to build a sentinel on lofty Tillamook Head, on the mainland south of present–day Seaside. Engineers cautioned against this, however, since Tillamook's extreme elevation often left it shrouded in clouds and fog. A better site appeared to be a mile offshore nearer the north–south shipping lanes at Tillamook Rock.

From the outset, getting on and off the rock proved the most difficult aspect of building and later tending the lighthouse. When the district superintendent was sent to survey the rock, he was forced to leap onto it from a pitching surf–boat. Unable to get his instruments landed safely, he proceeded to survey the rock with only a tape measure.

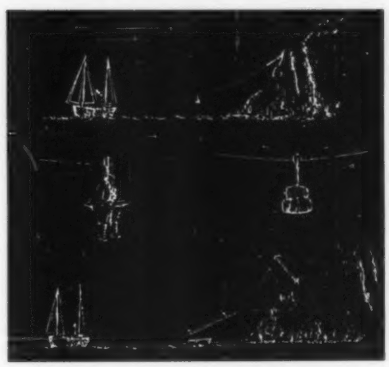
From the moment the first pick and chisel hacked into the rock, the public was mesmerized by the awesome danger involved in the undertaking. The sheer cliffs of Tillamook Rock drop straight down into the sea, and depths around the site range between 96 feet and 240 feet. The water is seldom calm here and never warm—a place fit for birds and sea lions, but not men.

At left is a perspective view from the northeast showing the Tillamook station as just completed. The original was done by the engineer, G.L. Gillespin but it was re-drawn by Karen L. DeAngelis. Gillespin also drafted the east side elevation (above, right). The early solution to getting men and equipment on the rock is shown at bottom, right. A breeches buoy and lifeline arrangement was used.



In September 1879—not long after blasting of the foundation began—master mason John Trewares drowned trying to leap onto the rock from a launch. Public outcry arose, and people demanded the project be abandoned. But construction boss Charles Ballantyne cleverly rounded up a new crew and sequestered them away at Cape Disappointment where gossip and inflammatory talk would not reach their ears.

While working on the site itself crewmen lived in canvas tents lashed to iron rings that had been driven into



the rock. Seawater often soaked their tents and ruined provisions. In addition, the men had to stand on a scaffolding of sorts to work on the rock face. When the wind kicked up or seas ran high, the scaffolding pitched and reeled, sometimes even awash.

A barracks was eventually built for the workmen, with a storehouse nearby for supplies. While the derrick was under construction, men got on and off the rock by means of a lifeline and breeches buoy, similar to the apparatus then in use to rescue shipwreck victims. The breeches buoy was far safer than the dauntless leaps the men had been making from surf-boats, but it was a less than comfortable ride. The supply vessel rolled miserably in Tillamook's unsettled waters, making the lifeline alternately slack and taut. The breeches buoy usually rode like a bucking horse. Rare was the occupant who was put ashore dry and unbruised.

An 1894 storm tossed boulders against the tower and smashed the lantern.

Two and a half years after the initial survey of Tillamook Rock, the lighthouse was completed. Its beam flashed out on January 21, 1881 to the cheers of crowds ashore, despite the cold weather. The beacon—elevated 131-feet above water with a 75,000 candlepower beam—could be picked up 22-miles at sea. The lighthouse had cost $123,000 and was among the nation's most expensive to build.

Life on the station was tolerable at best. Five keepers were assigned to duty with one always on leave. At first the men served three months, followed by two weeks leave, but discontent and a number of unusual ills—both physical and emotional—convinced the Lighthouse Service to institute a 42-day duty followed by 21-days leave. Since the government had stipulated Tillamook be a stag station, "far too confined for both sexes", no women ever served or lived on Tillamook Rock.

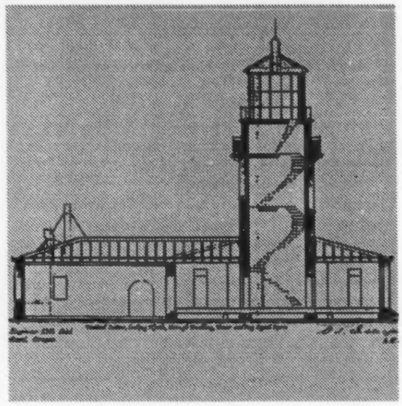
In 1890, to answer keepers' pleas for better communications with shore, a submarine telegraph cable was laid between Tillamook Light and the mainland. Only a year later, it was severed by storm seas and had to be reconnected. This scenario was to be repeated many times in the lighthouse's career.

Tillamook's keepers have told many incredible stories about life on the rock ...

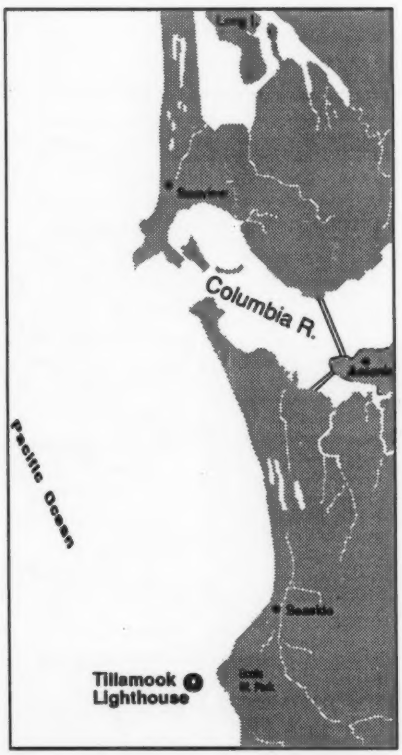
Numerous storms have battered the lighthouse, and the cost to repair it afterwards has far exceeded the original price tag. In 1882, only a year after the beacon was commissioned, a storm threw seawater over the lantern dome, causing enormous damage. An 1894 storm tossed large boulders against the tower and smashed the lantern. The light was out almost 24 hours while keepers cleaned sand, seaweed, and dead fish from the priceless prism lens.

The worst storm though, came in 1934 when winds of 110 mph lashed the rock, and stones as heavy as 150 pounds were hurled against the tower and onto the base platform. Henry Jenkins, the youngest of four keepers, was washed out of his brass bed after the sea broke off an estimated 25-ton piece of the western overhang of the rock. The severed chunk plunged into the sea and created an enormous wave that swamped the lighthouse.

Tillamook's keepers have told many incredible stories about life on the rock; many of the keepers were unbelievable characters themselves. Bob Gerloff, the "Grand Old Man of Tillamook Rock," became so enamored of the solitude and danger of the place



Above is the vertical section of the north view through the dwelling, tower and fog signal room of Tillamook Light. The drawing was prepared by the Lighthouse Engineer of the 13th District, Portland OR. The chart below shows the location of the light with reference to the Columbia River.



Tillamook Rock is among the most desolate and dangerous light stations in the United States and reflects the ever-present struggle between sea and shore along the rugged Pacific Northwest Coast.

Keeper W.T. Lawrence often amused himself with his camera. This memorable shot is a double-exposure Lawrence shot of himself dancing a jig and applauding himself at the same time. Photo courtesy of the Oregon Historical Society.

he once did a 5–year stretch of duty with no leave. After retirement, he asked to rent a room in the lighthouse but was denied. The government also disallowed his request to be buried at the lighthouse.

Keeper Roy Dibb played golf at the station by teeing off on a cotton golf ball attached with a cord to a railing stanchion. He also got exercise by jogging around the tower platform.

Life with Terrible Tilly was dull, to the point of silliness or even madness. Several keepers were relieved of duty after suffering mental breakdowns.

In 1957 the Coast Guard decided to close Tillamook Lighthouse. Its functions could be performed by a large buoy, and it had proven a very difficult and expensive station to man and maintain. It was ceremoniously closed up by the last head keeper, Oswald Alik, on September 10th with a poetic log entry: "Farewell, Tillamook Rock Light Station. I return thee to the elements...May your sunset years be good...your purpose is now only symbol."

Perspective lighthouse keepers can be found in every nook and cranny ...

Following retirement as an active beacon, the lighthouse held down a variety of occupations. A preservation group had not been able to raise funds to use the lighthouse for an historical purpose, so it was put on the auction block. The high bidder was Academic Coordinators of Las Vegas, who bought the structure for a mere $5600 in 1959.

Their use of it as an educational site never materialized, and it was resold in 1973 to a New York executive who wanted it for a vacation retreat. He used it just twice before selling it in 1978 to a wealthy Portland, Oregon bachelor.

The price tag had inflated to $27,000, and by now the lighthouse was covered with guano and inhabited by hundreds of seabirds. A lawsuit against the estate of the bachelor put the lighthouse in the hands of an elderly Eugene woman. She doubled the price and immediately resold it to a group of speculators in Portland.

Tillamook has become a sanctuary for departed souls who cannot leave the sea ...

What started out as a joke for this group—to convert the lighthouse into an offshore mortuary—turned into a serious financial operation. Today, *Eternity by the Sea Columbarium* fetches up to $25,000 per niche for those desiring to have their ashes interred on the rock. More than 400,000 niches are available, from the basement all the way to the top of the lantern.

Tillamook Lighthouse truly has found life after death. Perspective lighthouse keepers can be found in every nook and cranny, though they needn't worry about the storms that still pound the rock or sharing their cramped, secluded quarters with seabirds. Tillamook has become a sanctuary for departed souls who cannot leave the sea—even in death. Had devoted Keeper Bob Gerloff lived long enough, his wish for an eternity at Tillamook could have been granted.

The Zebra Mussel: A Recent Invader of North America

Thomas F. Nalepa
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Research Laboratory
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Ann Arbor, MI. 48105

The recent introduction and rapid spread of the zebra mussel (*Dreissena polymorpha*) in the Great Lakes has raised many concerns among water users in North America. This small bivalve mollusk attaches firmly to any solid substrate (rocks, piers, breakwalls, pipes, buoys, boat hulls, etc.) and already has disrupted operations of municipal and industrial water intakes in Lake Erie by restricting the flow of water through the pipes.

A single female can release up to 40,000 eggs into the water in a given year.

The zebra mussel is a native of the Black and Caspian Seas but spread through Europe at the beginning of the 19th Century with the increased use of waterways for transportation and trade. The mussel is a freshwater form, but it retained two unique characteristics of its marine ancestors which have been beneficial to its dispersion—byssal threads that allow it to attach to objects (such as boats) and then be transported to other areas, and floating larvae (called veligers) that are carried great distances by prevailing currents.

The zebra mussel was first discovered in Lake St. Clair in June 1988 and, based on age analysis, likely entered the Great Lakes sometime in late 1985 or 1986. The introduction of this species probably resulted from the discharge of freshwater ballast by ocean-going ships. Since its discovery, it has spread throughout Lake Erie and now is being found in Lake Ontario. A single female can release up to 40,000 eggs into the water in a given year. The eggs hatch into veligers which drift with the current for up to 30 days depending on the temperature. After this time period, the young settle out of the water and must attach to a hard substrate to continue development. Mussels reach maturity in their second year and have a lifespan of 3–5 years. Maximum size is less than 2 inches. Because of its high reproductive capacity, populations can increase very rapidly. Young mussels attach to old mussels thus building up *grape-like* clusters. At the intake canal of a power plant in western Lake Erie, abundances were less than 200 per square meter in the summer of 1988. By the same time the following year, abundances had increased to over 500,000 per square meter. The inside of the intake pipe of the Monroe, Michigan water plant became so clogged with zebra mussels that flow capacity was reduced 45%.

Besides the obvious impacts on raw water users, the mussel may alter the entire aquatic ecosystem. The adults filter up to 1 liter of water per day, feeding on the suspended algae that support the rest of the aquatic food chain. Water clarity in western Lake Erie has more than doubled as a result of the

mussels filtering this material out of the water column. While clearer water is certainly desirable, the mussels are in direct competition with other organisms which also feed on this material, such as zooplankton, which are an important food item in the diet of young fish. In addition, mussels are colonizing the rocky spawning reefs of western Lake Erie, potentially having a negative impact on the reproductive success of many fish including the walleye, an important game species.

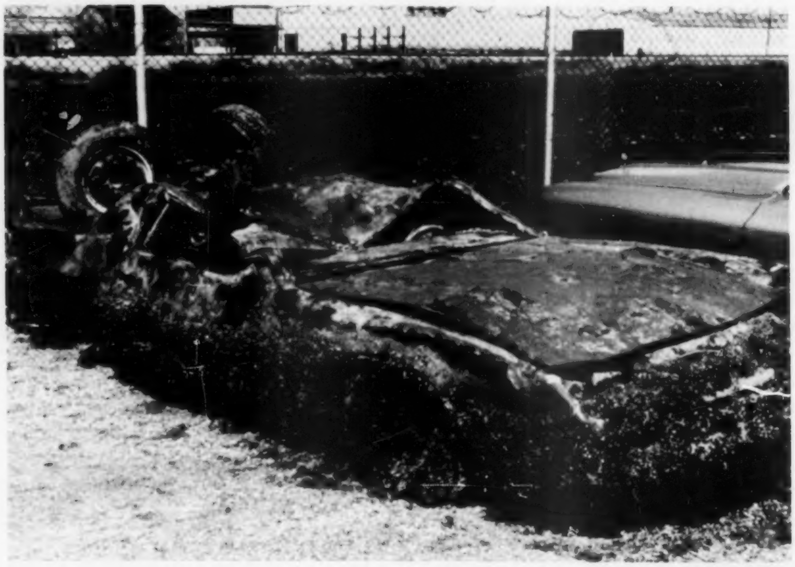
While the zebra mussel is being found in the stomachs of many fish species,

In time the mussel will enter the Mississippi River Basin... and the Hudson River Basin...

perhaps the greatest potential for natural control lies in their use by diving ducks. In many European lakes and rivers, large flocks of diving ducks seem to be keeping zebra mussel populations at low levels. Already along the northern shores of Lake Erie, increased numbers of diving ducks have been observed, apparently as a result of this abundant, readily available food source. Also, populations of diving ducks in Lake St. Clair are shifting distribution patterns, spending more time along the southern shore than the northern shore. Zebra mussels are more abundant along the southern shoreline.

Of course, natural predation cannot control the number of mussels inside pipes, hoses, screens and condensers of municipal and industrial users of raw water. Various measures have been used in Europe and the Soviet Union to control biofouling. Chemical controls include chlorination at the point of intake, copper sulfate, cynanuric acid, ammonium nitrate, and treatment with ozone. Other control measures include flushing with heated water (40°C), high pressure back wash, and periodic mechanical removal. Regardless of the methods eventually used in North America, the cost of control will be expensive. The City of Windsor, Ontario has already spent $1 million dealing with the problem.

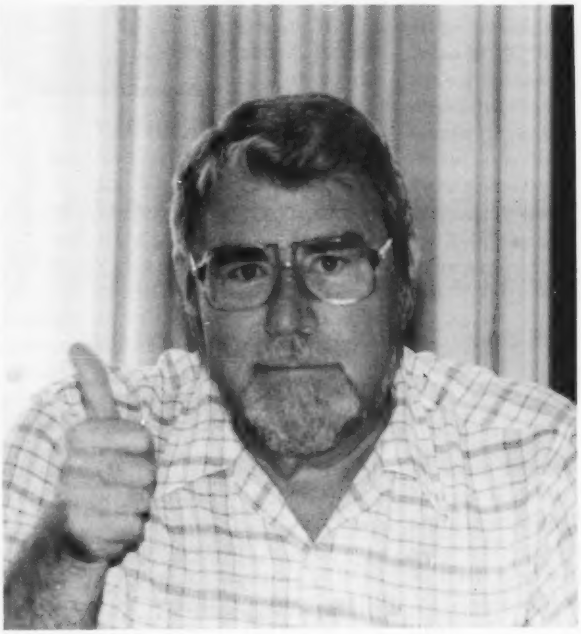
At present the mussel is found only in the lower Great Lakes, but over time it will likely be found throughout the Great Lakes and most of North America. Ships are constantly taking on ballast in the lower lakes and discharging it in the upper lakes before taking on cargo. Also, the large number of recreational boats in the Great Lakes will enhance dispersion. In time, the mussel will likely enter the Mississippi River Basin, through the Chicago diversion in Lake Michigan, and the Hudson River Basin through the Erie Canal in Lake Ontario. The spread of the zebra mussel out of the Great Lakes Basin will also occur when boats are trailored to other water bodies. The adult can live out of the water for up to 14 days. How far it will extend its range in North America remains unclear, but because of water temperature considerations, heavy infestations are not likely to occur in the deep south or in far northern latitudes.



Ron Griffiths

This car (left) was lying upside down in Wheatley Harbor, Lake Erie for 8 months. It is loaded with the zebra mussels. The photograph was taken by Ron Griffiths of the Ontario Ministry of the Environment. Since its discovery, in June 1988, the mussel has spread throughout Lake Erie and now is being found in Lake Ontario.

Getting to know your PMO



Earle Ray Brown, Jr. PMO, Norfolk

Earle Ray Brown, Jr. is the Port Meteorological Officer at Norfolk, VA. Ray's home base is located with the NWS at Norfolk but his territory covers a wide area of the Tidewater. He receives good support from the Weather Service Office in Norfolk as well as the Weather Service Forecast Office in Washington, DC. In addition, help is supplied by the Hampton Roads Maritime Association and the Virginia Port Authority. I want to thank Ray for taking time for this interview.

MWL: When you joined NWS was it as a PMO?

Ray: I started my career in the National Weather Service on Halloween 1955 (October 31) in Boston, MA with the Atlantic Weather Patrol. Between 1955 and 1962 I made about 50 weather patrols aboard USCG and MSTS ships.

MWL: What did you do before that?

Ray: I was in the U.S. Air Force from 1950–1954. I started out in 1950 on weather reconnaissance flights in RB-26C Bombers— a member of the *Plexiglass Posse*. I served at San Bernadino, CA, Kimpo, Korea and Tokyo, Japan during those wonderful years.

MWL: How about after the Atlantic Weather Patrol had seen its better days?

Ray: I was stationed at NASA's Wallops Is. facility providing weather support for NASA, mostly re-entry support with some down-range ship travel. We were also involved in the meteorological rockets ozone studies. I also did some travelling to places like Thule, Greenland, Bermuda, Barrow, AK, Peru and Brazil to name a few.

MWL: When did you finally settle down to the comfortable routine of PMO.

Ray: In 1980 I became the PMO at Norfolk, VA.

MWL: Have you had time for a family?

Ray: My wife and I just celebrated our 35th anniversary. We have four children, two are married. We also have three grandchildren with another due in May 1990.

MWL: Most people think of Norfolk as Navy. How does it rate as a commercial port?

Ray: Norfolk averages as about the sixth or seventh busiest port for ship's visits. The Hampton Roads area has three major terminals, two large coal terminals, and other smaller terminals that handle oil, grain, fertilizer, etc. Cities in the area include Chesapeake, Virginia Beach, Norfolk, Newport News, Portsmouth and Hampton.

MWL: Do you have occasion to interact with the Navy and Coast Guard?

Ray: Occasionally I will visit a Navy ship but I interact more with the Navy East Ocean Center (NEOC). This is headquarters for the U.S. Coast Guard's 5th District and there are four Cutters based here with two more to come. There is also a Coast Guard Communication Station in Chesapeake, so there is plenty of interaction with the Coast Guard.

MWL: Do many ships take observations in the Chesapeake Bay?

Ray: Lots of room for improvement here. Communications is a big problem. These observations can be helpful in studying the Bay. NWS has attempted to start an observation program for the Bay.

The VOS Program and the World Weather Watch

Martin S. Baron
National Weather Service
Silver Spring, MD 20910

The Voluntary Observing ship (VOS) program operates under guidelines established by the World Meteorological Organization (WMO). The principal purpose of the WMO is to promote the establishment and maintenance of meteorological programs and agencies capable of operating in harmony worldwide. Standardization is very important to meteorology, because of the global interrelationships and hemispheric movements of weather systems. Of particular importance is worldwide cooperation in the data gathering effort. The collection and processing of observations, which, increasingly, are automated and computerized, require uniform codes and observing procedures — WMO applied standards in effect throughout the world. The World Weather Watch (WWW) is the program by which the WMO coordinates, plans, and manages worldwide meteorological observing, data processing, and data dissemination programs.

The WWW is the basic program of the WMO, supporting all other programs and activities of the organization. This fundamental and essential role of the WWW reflects the importance of observations in meteorology. Observations describe the state of the atmosphere and the related environment, a knowledge of which is needed for all real time and non–real time meteorological applications. The measurements and instruments used in meteorology must be very precise.
The WWW is divided into three essential elements:

(a) The Global Observing System (GOS), consisting of facilities and arrangements for making measurements and observations at stations on land, at sea, and from aircraft, satellites, and other platforms. The Voluntary Observing Ship Program (VOS) is a very important part of the GOS, since it produces the vast majority of marine observations in use worldwide;

(b) The Global Data Processing System (GDPS), consisting of meteorological centers capable of processing meteorological data, preparing analyses and forecasts (realtime users), and being able to retrieve data and products (non–realtime users);

(c) The Global Telecommunications System (GTS), consisting of telecommunications facilities and arrangements necessary for the rapid and reliable collection and distribution of the observational data and products.

So the WWW is an integrated and coordinated system dedicated to the collection (GOS), global dissemination (GTS), and processing (GDPS) of observed data.

The observing program of the GOS is a composite system consisting of two major components— surface and space based subsystems. The surface based subsystem is composed of the basic synoptic networks (manned and automatic) of surface and upper air observing stations. It includes mobile (VOS program ships), fixed, and automatic sea stations, aircraft, climatological stations, and special stations such as weather radar, radiation, ozone, pollution, and tide stations. The satellite based subsystem consists of satellites, in both geostationary and near polar orbiting modes, capable of providing imagery, vertical profiles of temperature and humidity (soundings), and able to serve as data collection and dissemination platforms. Satellites have many other capabilities, including the ability to measure the temperature of land, sea, and cloud top, to determine snow and ice cover, and to monitor the incoming and outgoing radiation field passing through the atmosphere.
The GDPS is organized as a three–level system, consisting of:

(l) World Meteorological Cen-

ters (WMC's) in Melbourne, Moscow, and Washington.

(2) Regional Meteorological Centers (RMC's); 26 worldwide, including Algiers, Beijing, Bracknell, Buenos Aires, Montreal, Nairobi, Tokyo, and Wellington.

(3) National Meteorological Centers (NMC's); over 100 worldwide.

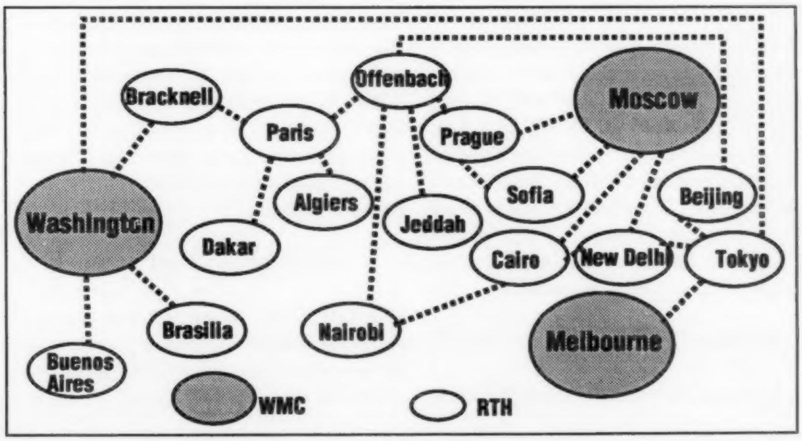
The WMC's are mainly concerned with providing products used for forecasting planetary, or large scale meteorological systems. The RMC's provide products used by NMC's to evaluate and forecast small and large scale systems. NMC's are equipped to receive guidance products from WMC's and RMC's for further processing, especially with respect to small (meso) scale systems. NMC's generate guidance products needed for use in local forecast operations. Complete, reliable, and timely observational data from the GOS is a prerequisite for the proper functioning of the GDPS.

The GTS links the GOS with the GDPS. Observations must be carried very rapidly regionally and internationally, without any delay, because WMC"s, RMC's, and NMC's have very demanding requirements for real time data. Ensuring the regular flow of meteorological information, both raw and processed, is the GTS's main concern.

Below, the chart shows the main circuits of the WMO Global Telecommunication System (GTS). The regional and national circuits (not shown) complete the global distribution of data. To the right is Dee Letterman the new Port Meteorological Officer for New York City.

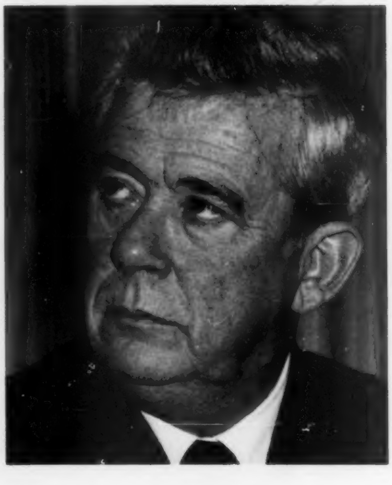
New PMO in New York

Dee H. Letterman is the new Port Meteorological Officer for New York City. Dee was born in Riverside, CA, but spent his childhood in many different places, the longest, for 7 years, in St. Petersburg, FL. He spent 14 years in the U. S. Air Force, first as an electronics technician for 3 years, and then as a weather observer/forecaster in Idaho, West Germany, Washington State, Alabama, and Wyoming. He came to the National Weather Service in 1985, at Casper WY, where he worked until selected for the PMO position. Dee received the Air Force Commendation medal in 1980 for the meteorological support he provided during the eruption of Mt. St. Helens. He has an associates degree in applied meteorology from the community college of the Air Force. Dee enjoys many outdoor activities, including fishing, hunting, boating, and camping. He is divorced, and has 2 sons.



Geoffrey Meek (right) was the well-known Toronto PMO for the past 21 years.

On his visit to Texas A&M, Vince Zegowitz (second from left) socializes with some students (far right). From left to right are Kathleen Costello (Biology), William Stacy (Marine Transportation), and Melisa Master (Marine Admisitration). In the background is the Aggie training vessel.



Canadian PMO Retires

Mr. Geoffrey T. Meek, PMO based in Toronto, Ontario for the past 21 years, retired on September 15, 1989. Geoff is well known and highly regarded in the marine community for his outstanding contributions to and work in marine weather services. He began his career with the British Royal Naval Reserve in 1947 and later served as an officer on merchant vessels sailing to Far and Middle East ports. Geoff moved to Canada in 1955 and joined the Atmospheric Environment Service in 1958 as an Ice Observer on ships operating in the Arctic. He was selected for the PMO position in Toronto in 1968. We wish him a happy retirement.

Head Honcho Visits Aggies

Vince Zegowitz, the Marine Observations Program Leader for the National Weather Service, recently visited Texas A&M University at Galveston's Maritime College to emphasize the importance of marine weather observations submitted from all ships at sea. Since maritime colleges in the U.S. are responsible for turning out the majority of merchant marine officers for American flag vessels, it is important that students realize the great value their weather messages have once they are at sea. Any maritime college or educational institution that would like a stimulating presentation on the Voluntary Observing Ship Program and the basics on generating a marine weather forecast should contact Vince Zegowitz at:

National Weather Service
Room 17312
1325 East West Highway
Silver Spring, MD 20910
301–427–7724

New VOS Program Plaque

The VOS program membership certificates, given to new ships after recruitment, are being replaced with walnut plaques that contain the NOAA Seal and the inscription "Voluntary Observing Ship Program Of The United States Of America". They will be given to all newly recruited vessels. There aren't enough on hand to distribute to all at the present, so please be patient.

Reminder To Use Prefix BBXX

As reported in the Fall, 1989 Mariners Weather Log, the WMO is asking all vessels using the ships synoptic code, FM13–IX ship, to use the header **BBXX** preceding the ships' call sign for regular weather reports, and preceding the words STORM, or SPREP, for storm or special reports. The **BBXX** header helps identify them as ship weather reports, on the GTS.

AMVER Clarification

There has been a misunderstanding about the impact transmitted meteorological observations have on position data for the Automated Mutual–Assistance Vessel Rescue (AMVER) System. There is no transfer of data between the VOS and AMVER programs— if you wish to update your position with AMVER, you must do so directly with the Coast Guard using the AMVER message code, at the prescribed times (departure, arrival, every 48 hours, route deviation).

Addition to Last Issue

The fall, 1989, Marine Observations Program article contained a review of the weather data acquisition methods over the oceans. Data sources men-

tioned included ships, satellites, fixed buoys, drifting buoys, aircraft, ocean weather stations, and mariner reports. A very important data source was not mentioned— fixed platforms, mainly operated and maintained by the oil industry. In many parts of the world, offshore oil platforms and drilling rigs provide real time data from data sparse areas. My apologies for this omission.

New Recruits

From October through December, 1989, Port Meteorological Officers recruited 50 vessels into the VOS program. The program now consists of 1484 high seas, and 72 Great Lakes vessels. The National Weather Service thanks all participating vessels for their diligence and cooperation in taking weather observations, and for contributing to the World Weather Watch.

New Recruits October –December 1989

AEL EUROPA	DKQP	NORTON LILY CO. INC.
AGNES	DVOZ	NATIONAL WEATHER SERVICE
AMERICO VESPUCCI	ICBA	SOUTHERN STEAMSHIP AGENCY
ARCTIC OCEAN	ELIG9	ECUADORIAN LINES
ATLANTIC OCEAN	ELIG8	ECUADORIAN LINES
BUNGA KATAN	9MYK	HYUNDAI MERCHANT MARINE INC.
CALGA	ELIH9	BCP SHIP LTD., SOVEIRGN HOUSE
CARIBAN	ZCAE6	BANANA SUPPLY COMPANY
CARTAGENA	ZFCB	SOUTHERN STEAMSHIP CO.
CENTURY HIGHWAY #2	8JFE	K LINE-KERR CORP.
CENTURY HIGHWAY #5	8JPX	STEVENS SHIPPING CO.
CRISTOFORO COLOMBO	ICYS	CONTAINERSHIP AGENCY INC.
DOLE ECUADOR	ICYK	WILLIAMS DIMOND AND CO.
EPTA	P3AA3	OFFSHORE OIL SER. (UK) LTD.
ERODONA	GXXQ	SHELL TANKERS & MARINE STORE
FETISH	OXBM6	BRANDTSHIP USA INC.
FRANCES HAMMER	KRGC	OCEAN CHEMICAL CARRIERS, INC.
GERORO	LAST2	ABEGWEIT SHIPPING CO.
GLORIA ELENA	H9YX	FOSTER SHIPPING AGENCY
HAWAIIAN RAINBOW	3EAP6	EAC TRANSPORT AGENCIES
HOEGH DUKE	VRPZ	STRACHAN SHIPPING CO.
HOLSTEN CARRIER	DHHO	NORTON LILLY CO., INC.
KOTA PETANI	J8BA2	PACIFIC INTL LINES (PTE), LTD.
LILLIAN	ELHA4	LOTT SHIP AGENCY, INC.
LIONS GATE BRIDGE	3EHX7	OOCL (USA), BUILDING 4B
MING PROGRESS	BLIN	LAVINO SHIPPING CO.
MING PROMINENCE	BLIL	LAVINO SHIPPING CO.
MOANA PACIFIC	OWUO6	USA UNITED STEAMSHIP AGENCY
MOANA WAVE	WUS9293	USA UNITED STEAMSHIP AGENCY
NAGASAKI SPIRIT	ELIQ2	TEEKAY SHIPPING CO. INC.
PAULINA	C6HD9	OMI CORPORATION
RELIANCE	S6AY	DENHOLM SHIP MGMT (UK) LTD.
SAN LUIS	C4YE	RIISE SHIPPING
STAR FRASER	ELEM3	STAR SHIPPING INC.
SWAN LAKE	LAP2	SALEN AGENCY INC.
TAMPA BAY	KNJA	GLENEAGLE SHIP MANAGEMENT CO.
TEMSE	ONAF	C.M.B. MEIR 1
TORRENS	LAVD2	BARBER WILHELMSEN AGENCY
TRADE GREEN	3EGY7	PACIFIC INTL LINES (PTE) LTD
TRANSWORLD BRIDGE	ELJJ5	KERR STEAMSHIP CO.
USCGC MUNRO	NGDF	COMMANDING OFFICER
USCGC PENOBSCOT BAY	NIGY	COMMANDING OFFICER
USCGC STURGEON BAY	NSXB	COMMANDING OFFICER
USNS ADVENTURUS	NADB	USNS ADVENTURUS
USNS BOLD	NIEY	USNS BOLD
USNS CAPABLE	NKSZ	MILITARY SEALIFT COMMAND
USNS LEROY GRUMMAN	NNLG	M.S.C. 09570-4095
USNS MAURY	NMRY	MILITARY SEALIFT COMMAND
USNS TENACIOUS	NTRG	USNS TENACIOUS
USNS WORTHY	NWTY	M.S.C. 0951-4092

Rogues Gallery Revisited

The photographs that follow show Outstanding Performance Awards given to selected ships in the VOS Program, installation of SEAS units aboard selected ships and other activities involving the Port Meteorological Officers.

The Canadian Port Meteorological Officers' Workshop was held in Montreal (above); top row (left to right)— Graham Campbell (PMO, Toronto), Ron McLaren (PMO, Vancouver), Don Sally (Canadian Navy, Esquimalt, B.C.), Mike McNeil (PMO, Halifax), Darryl Miller (PMO, St. John's, Nfld.), Bob McCarter (PMO, Vancouver); bottom row (left to right)— Denis Blanchard (PMO, Montreal), Ron Fordyce (PMO, Welland Canal), Vince Zegowitz (NWS, Marine Observation Program Leader), George Payment (Marine Meteorological Officer), Serge Dulude (Supt. Technical Services).

*To the left is a double award to the **Rainbow Hope**. One is for the VOS program and the other is for the SEAS program. Receiving the awards is Captain Tore Stromme and he is flanked by Ray Brown, Norfolk PMO (left) and Jim Farrington— SEAS Logistics Manager in Norfolk.*

*At top left Captain Joe Barron receives an Outstanding Performance Award on behalf of the crew of the **Chevron California**. The award was presented by Bob Novak, PMO San Francisco. The Captain of the **Senator** (top right) takes hold of his Certificate of Appreciation presented by a smiling Jim Farrington (left), who welcomes them to the program. At the bottom left Captain Albert D. Nelson displays the Outstanding Performance Award earned by the **Arthur M. Anderson**, one of the top reporters sailing the Great Lakes. The **Puritan** (bottom right) is the recipient of a Certificate of Appreciation for joining the VOS program. Jim Downing (left), the New Orleans PMO, is on hand for the ceremony.*

The Bob Collins Show

Bob Collins, PMO Chicago, has had a busy couple of months. From the 10th through 12th of October Bob spent some time in Sturgeon Bay, WI. He went at the request of the Commander of the Cutter ***Mackinaw*** to conduct refresher training for their weather observing staff. As it turned out, several Coast Guard Cutters were in for minor repairs, so a joint refresher training session was held aboard the ***Mackinaw***. They spent time discussing the gray areas of the observation program and Bob answered many of their questions. He also took the opportunity to provide each vessel with new 3-hourly interval observation forms and new cloud charts.

Bob also visited two new U.S. Navy Mine Sweepers that were also at Sturgeon Bay— the ***MCM5 Guardian*** and the ***MCM3 Century***. If this weren't enough he also stopped by the ***Shenehon*** and the ***Triton***. Then to top it all off he visited the ***Neeskay***, briefed her on the VOS program, conducted training, and signed her up.

In November he and Jim Farrington, the SEAS Logistics Manager from the Atlantic Marine Center, traveled to Ludington, MI and Whiting, IN to install SEAS units and train the Captains and crews in the operation of the system.

The trip included stops aboard the NOAA vessel ***Shenehon***, from Grand Haven, MI, the Michigan Wisconsin Transportation Company's ***Badger*** and Inland Steel Corporation's ***Edward L. Ryerson***.

While aboard the ***Badger***, Jim and Bob installed the SEAS system, which consists of a lap top computer, transmitter and antenna. The installation was performed while the vessel was underway. Lake Michigan, was providing 30–knot winds with a wind chill of about 3°F. This made for an interesting installation on top of the bridge. After the training was completed, they were able to monitor the crews first transmission, via the SEAS system, and all went well. The ***Badger*** is a car ferry that traverses Lake Michigan twice daily in winter and four times a day in the summer months. She is capable of carrying a wide variety of loads including railroad cars, autos, trucks and other heavy equipment. Owned and operated by the Michigan Wisconsin Transportation Company, the ***Badger*** operates between Ludington, MI and Kewanee, WI.

They also stopped aboard the ***Shenehon***, which already had a SEAS unit, and made some equipment changes more appropriate to Lake operations.

A third unit scheduled for the ***Wilfred Sykes*** was not installed as the vessel was weathered in at Escanaba, MI. Jim and Bob wish to express their thanks to the Captains and Mates of the ***Badger***, ***Ryerson*** and ***Shenehon*** for their cooperation and enthusiasm.

Bob held a joint briefing session aboard the Mackinaw (above left). Attending were crews from the U.S. Coast Guard Cutters Mackinaw, Neah Bay, Bristol Bay, Sundew , Mobile Bay and Katmai Bay. Above right is the old Coast Guard Station at Kewanee, WI. It is now the Snug Harbor Restaurant and the Badger ties up next to the ramp on the left.

Captain Masse and Jim Farrington check things out from the Badger Bridge (upper left) and Jim shows him the SEAS procedures (middle right). The Badger (middle left) is in Ludington, MI, one of its two ports of call. In the lower left Bob uses whats left of his hair to take a wind ob on the top of the Badger's bridge. Inland Steel's Wilfred Sykes finally gets its SEAS unit (upper right). Mates Riley Word (left) and Eric Sawyer (center) seem pleased to take the unit from Bob. (Bob warned us to keep photos of himself to a minimum as he didn't want to steal Jim Nelson's title of NOAA's most photographed PMO.) At the bottom right the Edward L. Ryerson is seen coming into Indiana Harbor prior to her SEAS unit being installed.

Global Maritime Distress and Safety System

After reading REO John Ford's letter last fall in MWL, I was really stirred up and anxious to support him with a follow–up letter of my own.

GMDSS is a big money making scheme. That's all. Sure it might work after a fashion. However, as stated by Mr. Ford and then Mr. Bourassa there are too many easy ways to sabotage satellite communications.

In war, it would be prudent to knock out satellites first. And if this were done with a nuclear device, propagation would be disrupted so that the only mode usable would be Morse.

I was inolved in a hearability test in the early 1970's where a group of radio operators monitored the high frequency range subsequent to a nuclear blast set off by a communist country. For 48–72 hours after the blast, the only thing that would get through the normal high frequency paths was Morse, and the signals were way down and watery–sounding. Voice transmissions were useless, and unstable atmospherics would not support the use of radio printers of any kind.

What I've stated is a fact, and is a major consideration for rejuvenating Morse skills in the U.S. Navy. In fact, in 1983, Commander in Chief, Atlantic Fleet sent a party of officers to the Naval Technical Training Center, at Corry Station, Pensacola, Florida to find out what types of training devices were available to purchase and ultimately be placed aboard Atlantic Fleet ships for Morse proficiency training. I understand that they bought a bunch of code trainers from AEA up in Washington State.

On the other hand, the idea of GMDSS also includes changing the concept of distress communications from the present ship–to–ship, to ship–to–shore.

All I can relate about this is that I've been inolved in a few distresses and the help always came from nearby ships. I suppose you punch your satellite emergency button and some coast station operator might go look at his or her printer and call the Coast Guard who will check their AMVER Computer for a nearby ship, and then send a telex to a nearby ship via satellite (and some mate is really going to go check the printer.... right away – that is .... figure the odds).

The thing about even authorizing ships to be Radiotelephone ships is shakey— especially vessels that go foreign. The language barrier is so great in the majority of cases that, if the helping party in a radiotelephone distress situation isn't too cosmopolitan, or happens to have an interpreter handy, the distressed vessel is, for lack of better or more descriptive words, screwed.

The current system, 500 kHz Morse distress and calling, and the good old autoalarm is a time–proven dinosaur that works. It incorporates the best of human skills and with the use of international telegraphic abbreviations and Q– and Z– signals, one can communicate with virtually anyone regardless of native tongue.

INMARSAT, SITOR direct telex and all the modern conveniences are fabulous, however they are a lot of whistles and bells that can all "crap out" with a little static electricity or a slight surge of the old ship's generator, leaving the best of us REO's in a world of you–know–what, if y'aint got the parts onboard. But on the other hand, most of us can get a Morse rig on the air pretty post haste under the worst of conditions.

So you can see GMDSS just isn't practical. Nice but not reliable or something you can stake your life on. I would much rather get on 500 kHz and talk to another Radio Officer— which will be the case after I send my SOS or my four 4–second dashes (if I have to wake him or her up).

Let the electronics moguls think of something else to mess with.

Thomas L. Dixon
R/O SS *Pecos*

More on GMDSS

It has been with a mixed feeling of nostalgia, on the one hand, and wry cynicism on the other, that I have monitored the progress of "phasing out sparky."

However, I base all statements to follow on sheer pragmatism, For one thing, the remarks about the dependability and the effectiveness of Marisat/Satcom in truly distress situations are quite true: that there is no reserve means of powering up the ship marisat unit, in case of catastrophic engine room accident, and the satellite-seeking antenna cannot operate in the stated condition of serious listing. It would be unwise to premise any lifesaving system on the notion that "there will always be a.c. power," and "the ship will not list that much in any emergency."

In point of fact, while reliability of the Satcom/Marisat is outstanding, and it is a superior means of communicating when it is all working, it can, as any other piece of manmade equipment, malfunction, even in flat seas and normal ship status.

In recent days our ship has received numerous repeated messages of sailing vessels and larger vessels unreported. In both cases, an EPIRB was listed, along with VHF-FM, sideband, etc. If deployed, the EPIRB alone would enable location of the EPIRB, and hopefully, it is still attached to the vessel or at least to the liferaft, lifeboat, dinghy, etc. of the unfortunate vessel. Evidently these vessels EPIRBs did not deploy. Nor are these unique or isolated instances of loss of ship and crew without a trace. So much for that much of the sophisticated systems.

If the S/V or the larger vessel, lost in the vicinity of Azores and the British Islands, had a simple 500-kHz radio (even permitting it to operate as a voice — AM set) they could have been very likely received by some 500-kHz watchkeeper, so long as 500 kHz watches continue on ships and at shore stations.

I am not making a brief for morse code, although it ought always be a requirement for emergency signaling (radio or lights). My concern is not even primarily for the radio operator's position, although I have been one for many years.

No, my concern is for the headlong and heedless rush into the systems that depend upon the uninterrupted proper operating of an integrated system, with the components of such a system using literally tens of thousands of discrete electronic parts, as well as depending upon no interruption of the normal and ideal signal routes. The system is indeed susceptible, vulnerable to mischief and to just ordinary breakdown. If you have no dependable backup system, too bad.

Messrs, Bourassa and Ford, in these columns, treated all of the above possibilities. They are fellow radio officers. But I would close my comment with recall of some other things done by R.E.O.'S that may not be in proper focus.

On every vessel I have sailed, there has come a time when I am requested to "look at the port radar;" "the starboard radar is out;" "the VHF has quit;" and even, "can you check into the automatic pilot and see if you find the problem?"

It is my professional satisfaction to say that in most cases I have been able to restore these units to operation. While on the R/V *Knorr*, in fact, I also repaired the cycloid indicating system, and that involved rebuilding a small potentiometer used to sense pitch changes, and then calibrating the system again. The *Knorr's* autopilot also went awry, and I found, deep inside it, a leaky disk capacitor to be the problem. I also repaired the VHF receiver-transmitter used to maintain contact via a NOAA satellite.

You may not need "sparks" around much longer. You may not wish to think of morse code. But you had better very well have someone onboard who knows how to solder, and to troubleshoot, and knows the difference in a diode and a suppository.

As to the comment by USCG Chief Joseph D. Hersey, Jr. in the summer, 1989 Log, "...Morse..relies on...another vessel or coast station, to be relatively close (on the order of 250 nm) to the vessel in distress...." He states this to be disadvantage. Au Contraire, I feel that, and I teach that you would very much wish to attract the attention of ships in your near vicinity—preferably within 25 miles—when you must abandon ship. Those further away will be of precious little help to you.

It seems that the dependence upon all the high tech equipment, and the systems they work with, for absolute salvation, is like an aspect of professional (TV) wrestling: Both depend upon a friendly cooperation at all times, for their successful presentation. In the real world, whether of unrehearsed combat or of unrehearsed sea disaster, these niceties simply do not apply. You cannot wink at tragedy at sea.

Aaron W. Edwards – REO
SS *Coastal Manatee*/KGXM

Although I have been told that this is not the right forum for the discussion of the GMDSS system, I feel that ,if nothing else, it provides some education for the layman and an outlet for the radio officers, who play an important role in weather observations at sea.

—ed.

Ship Weather Headings and other Information

Julie L. Houston
National Weather Service
Silver Spring, MD 20910

Ship Weather Reports

All ships weather reports transmitted to shore should include **BBXX** as the first group in the text followed by the **ship call sign.**
Example:
BBXX VCTB 29003 99131 70808 41988 60909 10250 20211/ 40110 52003 71611 85264 22234 00261 31100 40803

BATHYTHERMAL/TESAC Observations

Ships are reminded to use the correct format for Bathythermal/Tesac Observations. Bathys/Tesac should start with JJXX and end with the Call Sign.

EXAMPLE: **JJXX** 20106 0312/ 74519 05528 88888 00098 26097 28098 29094 33069 36044 37026 38014 39009 41004 46503 48505 59508 84512 9901 36512 37512 38512 39355 46355 0000 **VCTB**

INMARSAT Format Example

BBXX VCTB 29003 99131 70808 41998 60909 10250 2021/ 40110 52003 71611 85264 22234 00261 31100 40803 ....

INMARSAT Reports Procedure

INMARSAT Equipped ships may transmit weather messages using the following procedures after the message is composed off-line:

1. Select U.S. Coast Earth Station Identification CODE 01.
2. Select routine priority.
3. Select duplex telex channel.
4. Initiate the call.
   Upon receipt of GA (Go Ahead).
5. Select dial code for meteorological reports, 41, followed by the end of selection signal, +.
   41+ (or 00 23 6715250+)
6. Upon receipt of our answerback, NWS OBS MHTS, transmit the ships call sign and the weather message only. Do not send any other preamble.

Available

Information concerning Coast Earth Station ID codes and Telex and Telephone Country Codes can be found in the INMARSAT Users Guide. The Users Guide is available at the address below:

COMSAT Maritime Services
950 L'Enfant Plaza, S.W.
Washington, DC 20024

ATTN: James Jansco

Selected Worldwide Marine Weather Broadcasts

The 1989 editionof Selected Worldwide Marine Weather Broadcasts is available from:

Superintendent if Documents
U.S. Government Printing Office
Washington DC 20402

The cost is $9.00. Please refer to Stock No. 003–017–00534–8 when ordering. If your vessel is in the VOS program you can obtain a free copy from your PMO.

Please send any changes to the publication **Selected Worldwide Marine Weather Broadcasts** to the following address:

National Weather Service
International Telecommunications
Section W/0S0151 ROOM 419
8060 13th Street

NAIROBI 1, KENYA

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
5YE1	9043 kHz	CONTINUOUS	F3C	6 KW
5YE3	17365 kHz	CONTINUOUS	F3C	6 KW

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP
AREA				
0010	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	1200	B
0350	TEST CHART	120/576		
0400	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	1800	A
0540	24HR SIGNIFICANT WEATHER PROG (LOW LEVEL)	120/576	1800	A
0600	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	1800	B
0830	TEST CHART	120/576		
0844	24HR 500MB PROG	120/576	0000	B
0903	24HR 300MB PROG	120/576	0000	B
0922	24HR 250MB PROG	120/576	0000	B
0941	24HR 200MB PROG	120/576	0000	B
1000	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	0000	A
1017	24HR SIGNIFICANT WEATHER PROG (HI LEVEL)	120/576	0000	A
1037	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	0000	B
1057	SURFACE ANAL	120/576	0600	D
1112	UPPER AIR ANAL	120/576	0600	D
1127	24HR PRESSURE CHANGE	120/576	0600	D
1142	24HR SURFACE PROG	120/576	0600	D
1210	700MB ANAL	120/576	0600	B
1229	500MB ANAL	120/576	0600	B
1248	300MB ANAL	120/576	0600	B
1307	250MB ANAL	120/576	0600	B
1326	200MB ANAL	120/576	0600	E
1345	SURFACE ANAL (INDIAN OCEAN)	120/576	0600	E
1430	LOW LEVEL CONVERGENCE ZONES	120/576	1200	C
1455	24HR PRESSURE CHANGE/VARIATION	120/576	1200	D
1600	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	0600	A
1638	SURFACE ANAL	120/576	1200	D
1653	850MB ANAL	120/576	1200	D
1708	SURFACE ANAL (INDIAN OCEAN)	120/576	1200	E
1722	24HR SIGNIFICANT WEATHER PROG (HI LEVEL)	120/576	0600	A
1742	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	0600	B
1802	24HR SURFACE PROG	120/576	1200	D
1820	700MB ANAL	120/576	1200	B
1839	500MB ANAL	120/576	1200	B
1858	300MB ANAL	120/576	1200	B
1917	250MB ANAL	120/576	1200	B
1936	200MB ANAL	120/576	1200	B
2055	24HR 500MB PROG	120/576	1200	B
2114	24HR 300MB PROG	120/576	1200	B
2133	24HR 250MB PROG	120/576	1200	B
2152	24HR 200MB PROG	120/576	1200	B
2210	24HR SIGNIFICANT WEATHER PROG (MID LEVEL)	120/576	1200	A
2350	24HR SIGNIFICANT WEATHER PROG (HI LEVEL)	120/576	1200	B

MAP AREAS:	A - 1:15,000,000	30N 005W,	30N 070E,	30S 005W,	30S 070E
	B - 1:25,000,000	55N 020W,	55N 090E,	35S 020W,	35S 090E
	C - 1:07,500,000	22N 025E,	22N 060E,	02S 025E,	02S 060E
	D - 1:15,000,000	30N 015E,	30N 070E,	30S 015E,	30S 070E
	E - 1:15,000,000	20N 030E,	20N 070E,	30S 030E,	30S 070E

(INFORMATION DATED 07/1989)

BRACKNELL 1, UNITED KINGDOM

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
GFA21	3289.5 kHz	CONTINUOUS	F3C	30 KW
GFA22	4610 kHz	1800-0600	F3C	30 KW
GFA23	8040 kHz	CONTINUOUS	F3C	30 KW
GFA24	11086.5 kHz	CONTINUOUS	F3C	30 KW
GFA25	14582.5 kHz	0600-1800	F3C	30 KW

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
/1400	RADIO FREQUENCY CHECK			
0305/--	36HR SURFACE/1000-500MB THICKNESS PROGS	120/576	1200	
XX4				
0317/1516	PRELIM 500MB ANAL/1000-500MB THICKNESS ANAL	120/288	00/12	H
/1522	30-DAY TEMP OUTLOOK	120/576		
0341/1541	SURFACE ANAL	120/288	00/12	F
/1602	SEA ICE	120/576	--	E
/1622	GENERAL NOTICES	120/576		
0431/1631	24HR SURFACE PROG	120/288	00/12	F
0438/1708	500MB/1000-500MB THICKNESS ANAL	120/288	00/12	A
0448/1720	300MB ANAL	120/288	00/12	A
0458/1730	200MB ANAL	120/288	00/12	A
0508/--	100MB ANAL	120/288	0000	A
0518/1740	700MB ANAL	120/288	00/12	A
/1750	100MB ANAL	120/288	1200	A
0528/1800	850MB ANAL	120/288	00/12	A
0630/1820	24HR 500MB/1000-500MB THICKNESS PROGS	120/288	00/12	A
0640/1830	24HR 300MB PROG	120/288	00/12	A
0650/1840	24HR 200MB PROG	120/288	00/12	A
/1850	24HR 100MB PROG	120/288	1200	A
0700/1900	24HR 850MB PROG	120/288	00/12	A
0710/--	48HR & 72HR SURFACE PROG/ 48HR & 72HR 500-1000MB THICKNESS PROGS	120/288	0000	C
0720/1910	24HR 700MB PROG	120/288	1200	A
/1920	500MB ANAL	120/576	1200	
XX11				
0812/--	SURFACE ANAL (NORTHERN HEMISPHERE)	120/288	0000	D
0901/--	24HR 100MB PROG	120/288	0000	A
0920/--	500MB ANAL (NORTHERN HEMISPHERE)	120/288	0000	D
0929/2012	WAVE HT ANAL	120/288	00/12	G
0935/2018	24HR WAVE HT PROG	120/288	00/12	G
0941/2141	SURFACE ANAL	120/288	06/18	F
0959/--	36HR 500MB PROG	120/576	0000	
XX10				
1010/2152	48HR SEA/SWELL PROG	120/288	00/12	G
1031/--	24HR SURFACE PROG	120/288	0600	F
/2222	48HR & 72HR SURFACE PROGS/ 48HR & 72HR 500-1000MB THICKNESS PROGS	120/288	1200	C
1037/--	48HR 500MB VORTICITY PROG	120/576	00/12	
XX11				
/2231	24HR SURFACE PROG	120/288	1800	F
1103/--	72HR 500MB PROG	120/576	0000	
XX11				
/2237	48HR 500MB VORTICITY PROG	120/576	1200	
XX10				
1114/--	36HR SURFACE/1000-500MB THICKNESS PROGS	120/576	0000	
XX4				
1131/--	5-DAY MEAN 700MB HEIGHT	120/576		
XX11				
/2333	36HR 500MB PROG	120/576	0000	
XX10				
/2345	72HR 500MB PROG	120/576	1200	
XX11				

MAP AREAS:	SCALE				
A	1:20,000,000	48N 145W,	32N 068E,	24N 069W,	15N 010E
C	1:30,000,000	42N 090W,	66N 090E,	20N 040W,	30N 020E
D	1:30,000,000	29N 158W,	29N 063E,	08N 085W,	08N 005W
E	1:10,000,000	57N 096W,	71N 071E,	38N 048W,	46N 013E
F	1:20,000,000	69N 111W,	37N 050E,	34N 055W,	19N 010E
G	1:20,000,000	38N 114W,	60N 032E,	19N 077W,	30N 009W
H	1:20,000,000	72N 035W,	46N 032E,	41N 035W,	29N 004E
XX4	1:40,000,000	26N 138E,	26N 014W,	09N 163W,	09N 073W
XX10	1:40,000,000	01N 032W,	01N 129W,	14N 030E,	14N 171E
XX11	1:40,000,000	01N 032W,	01N 129W,	11N 037E	10N 163E

(INFORMATION DATED 07/1989)

MELBOURNE, AUSTRALIA

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
AXM 31	2628 kHz	CONTINUOUS	F3C	5 KW
AXM 32	5100 kHz	CONTINUOUS	F3C	5 KW
AXM 34	11030 kHz	CONTINUOUS	F3C	5 KW
AXM 35	13920 kHz	CONTINUOUS	F3C	5 KW
AXM 37	19690 kHz	CONTINUOUS	F3C	5 KW

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
0000/1200	36HR SURFACE PROG	120/576	00/12	B
0030/--	12HR SURFACE PROG	120/576	0600	C2
/1230	500MB ANAL	120/576	0000	A1
0045/--	24HR SURFACE PROG	120/576	0000	B
0100/--	RECOMMENDED FREQUENCIES FOR RECEPTION	120/576		
/1300	36HR SURFACE PROG	120/576	1200	A2
0115/--	FACSIMILE SCHEDULE	120/576		
/1345	ANTARCTIC SUPPORT CHARTS	120/576		
0200/--	SATELLITE IMAGERY	120/576	0000	F
0210/1430	SURFACE ANAL	120/576	00/12	B
0300/1500	500MB ANAL	120/576	00/12	C1
0315/--	250MB ANAL	120/576	0000	C1
/1515	24HR SURFACE PROG	120/576	1200	B
0330/1530	12HR SIGNIFICANT WEATHER PROG	120/576	06/18	G
0345/1545	12HR SIGNIFICANT WEATHER PROG	120/576	06/18	C2
0400/1600	24HR 500MB PROG	120/576	00/12	C1
0415/1615	24HR SURFACE PROG	120/576	00/12	B
/1715	250MB ANAL	120/576	1200	C1
0530/1730	24HR 250MB PROG	120/576	00/12	C1
0545/--	MAX WIND/TROPOPAUSE ANAL	120/576	0000	C1
0605/1745	GRADIENT LEVEL WIND ANAL	120/576	00/12	D1
0615/1830	12HR SIGNIFICANT WEATHER PROG	120/576	12/00	C2
0645/--	ANTARCTIC SUPPORT CHARTS	120/576		
0715/1915	SURFACE ANAL	120/576	00/12	A2
0730/--	24HR WIND WAVE PROG	120/576	0000	B
0745/--	24HR SWELL HT PROG	120/576	0000	B
0800/2000	SURFACE ANAL	120/576	00/12	A3
0815/2015	SURFACE ANAL	120/576	06/18	B
0830/2030	24HR 250MB PROG	120/576	00/12	G
0845/2045	24HR 250MB PROG	120/576	00/12	H
0915/--	12HR SIGNIFICANT WEATHER PROG	120/576	12/00	C2
/2115	30HR 250MB PROG	120/576	1800	H
0930/2130	12HR SIGNIFICANT WEATHER PROG	120/576	12/00	G
0945/--	36HR 250MB PROG	120/576	1200	A3
/2145	18HR SIG WX PROG	120/576	1200	G
1000/2200	30HR 250MB PROG	120/576	06/18	G
1015/--	30HR 250MB PROG	120/576	0600	H
/2215	SURFACE ANAL	120/576	1200	A1
1030/--	48HR 500MB PROG	120/576	0000	A1
/2230	36HR 250MB PROG	120/576	0000	A3
1045/--	48HR SURFACE PROG	120/576	0000	A1
/2245	36HR 500MB PROG	120/576	1200	A1
1100/--	SURFACE ANAL	120/576	0000	A1
/2300	48HR SURFACE PROG	120/576	1200	A1
1115/--	WEEKLY MEAN SST ANAL (TUE)	120/576	--	D1
WEEKLY SST ANAL OF SE AUSTRALIAN WATERS (TUE)		120/576	--	-
	ICE BOUNDRY (SAT)	120/576	--	-
1130/--	12HR SIGNIFICANT WEATHER PROG	120/576	1800	C2
/2330	500MB ANAL	120/576	1200	A1
1145/--	36HR COMBINED WAVE HT PROG	120/576	1200	A1
/2345	48HR SURFACE PROG	120/576	1200	A2

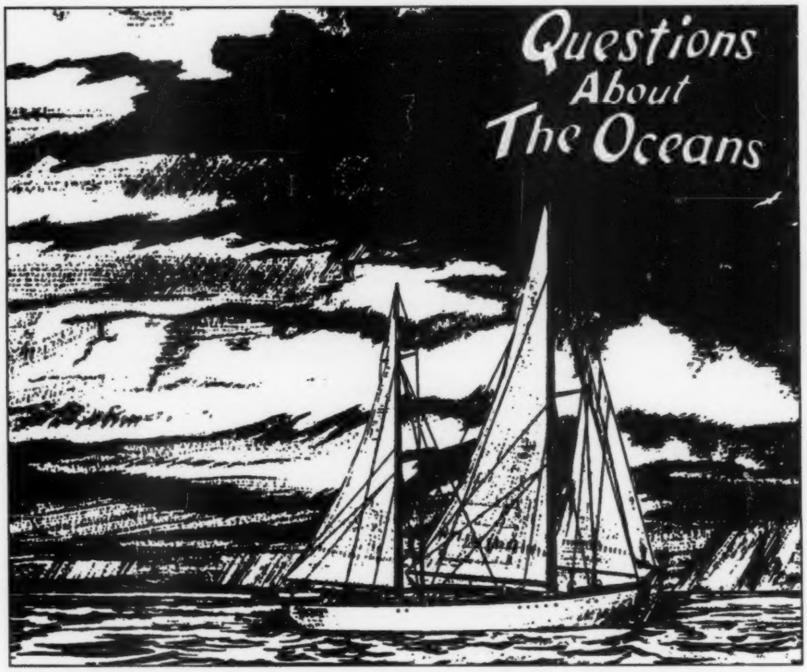
NOTES: 1. RECEPTION AREA IS SOUTHWARDS OF 10N, BETWEEN 70E & 150W.
2. AS AVAILABLE, SUMMER ONLY.

MAP AREAS:

A1	- 1:60,000,000	SOUTHERN HEMISPHERE
A2	- 1:40,000,000	05N 052E, 05N 128E, 22S 000 , 22S 180
A3	- 1:40,000,000	08N 160W, 39S 008W, 07S 154E, 07S 078W
B	- 1:20,000,000	10S 090E, 10S 170E, 55S 090E, 55S 170E
C1	- 1:20,000,000	10S 100E, 10S 180 , 50S 100E, 50S 180
C2	- 1:20,000,000	EQ 100E, EQ 180 , 50S 100E, 50S 180
D1	- 1:20,000,000	23N 100E, 23N 180 , 23S 100E, 23S 180
F	- SOUTHERN HALF	OF EARTH'S DISK FROM JAPANESE GMS SATELLITE.
G	- 1:35,000,000	50N 100E, 50N 180 , 50S 100E, 50S 180
H	- 1:35,000,000	50N 030E, 50N 110E, 50S 030E, 50S 110E

(INFORMATION DATED 07/1989)

Questions About the Oceans



One of the more interesting functions at the National Oceanographic Data Center (NODC) is answering the many questions concerning the oceans. Some 25 years ago NODC published a booklet entitled *Questions About the Oceans* by Harold W. DuBach and Robert W. Tabor. The artwork was done by Edwin J. Seremeth. This booklet was an NODC bestseller. It is long out of print, but many of the same questions are still being asked. This column will attempt to update the book and possibly even add some new questions and answers using the experts here at the data center. This first column will begin with the booklet's cover and story on the Atlantis.

The A–Boat

It is doubtful that the many new fairly luxurious, research vessels ever will obtain the affection and nostalgia reserved for the famed *Atlantis*.

The *Atlantis*, designed and built for the Woods Hole Oceanographic Institution in 1931, sailed about 1 million miles in some 30 years during 270 cruises lasting from a few days to 6 or 7 months. On the average, the ship was at sea 250 days a year, working in the North and South Atlantic and adjacent gulfs and seas, the Pacific and Indian Oceans, and the Red Sea. Her two capable deep sea winches were used thousands of times to probe the ocean at all but the greatest depths. The *Atlantis* probably made more hydrographic stations than any other ship. More important, she was the principal instrument in advancing the growth of modern knowledge of the ocean. Young men who became leaders in oceanography obtained their sea legs on her. Her work in the Gulf Stream greatly advanced our knowledge of that vast current. Regardless of her small size, she did a tremendous amount of work. Her accommodations were none too luxurious and she was not air conditioned. Yet, the small number in her crew (19) and the scientific party of eight or nine made for a great camaraderie and created a stubbornness to get the work done, regardless of difficulties.

The *Atlantis* was a lucky ship. She went through many a fierce storm and several hurricanes with but minor damage. She never lost a man overboard nor was anyone seriously injured. On November 11, 1966 the A– boat as she was known, left Woods Hole to continue her career under the name of ***El Austral*** for the Hydrographic Office of the Argentine Navy.

Jan Hahn
former Editor,
Oceanus

When it's done holding your ship's garbage, it could hold death for some marine animals.

This plastic trash bag may not look like a jellyfish to you. But to a hungry sea turtle, it might. And when the turtle swallows an empty bag, the mistake becomes fatal.

The problem is more than bags. Plastic six-pack holders sometimes become lodged around the necks and bills of pelicans and other seabirds, ultimately strangling or starving them. Other plastic refuse, either through ingestion or entanglement, causes the deaths of thousands of seals, whales, dolphins and other marine mammals every year.

Plastic debris also causes costly and potentially hazardous delays to shipping when it fouls propellers or clogs intake ports.

It's a critical issue, destined to attract public and government scrutiny if we fail to take action to solve it.

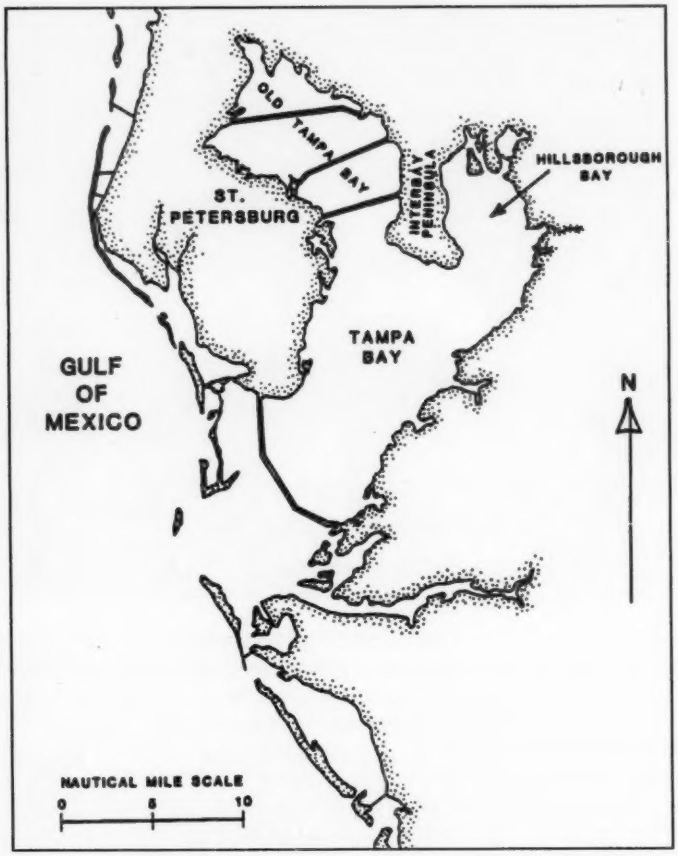
So please, stow your trash, and alert your shipping terminals that you will need proper disposal on land. A sea turtle may not know any better. But now, you do!

To learn more about how you can help, write: Center for Marine Conservation, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Marine Conservation
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Tampa Bay as a Hurricane Haven

Samson Brand
NOARL West
Montery, CA 93943



Tampa's location in the hurricane belt, lack of sheltered facilities, and vulnerability to storm surge render it a poor hurricane haven. Evasion at sea is recommended for all seaworthy deep-draft vessels when Tampa is threatened by an intense tropical storm or hurricane approaching from the Gulf of Mexico or a hurricane approaching overland across the Florida Peninsula.

Small craft should be removed from the water and firmly secured above the predicted high water line. Otherwise, seeking shelter in the upper reaches of the Hillsborough, Alafia, or Little Manatee Rivers is recommended.

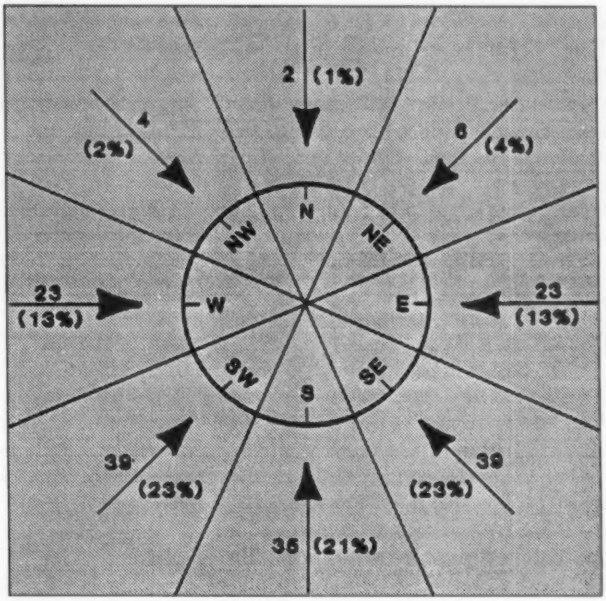
The Setting

Tampa is located at the approximate mid-point on the west coast of the Florida Peninsula. The city and Port of Tampa lie at the north end of Hillsborough Bay, an arm of Tampa Bay. Approximately 6 to 7 miles wide and some 20 miles long, Tampa Bay serves not only as an access to the Port of Tampa, but also the Port of St. Petersburg and Port Manatee.

The land surrounding Tampa Bay is generally low in elevation and has been developed for homesites or industrial purposes. Except for a section of southern Pinellas Peninsula, few elevations reach 30 feet within 3 miles of the bay.

For deep-draft vessels, the main ship channel passes between Egmont Key and Mullet Key into a

Directions of approach of tropical cyclones that passed within 180 nautical miles of Tampa during the period 1871–1979 are indicated. Numbers of storms approaching from each octant and percentage of the total approaching from that octant are displayed.



dredged cut that enters Tampa Bay. A Federal project provides for depths of 36 feet in the entrance from the Gulf of Mexico, then 34 feet to Tampa and Port Tampa.

Water depths in Tampa Bay vary, but are generally shallow with depths less than 15 feet outside the natural channel through which the dredged channel is cut. The waters of Old Tampa Bay and Hillsborough Bay are uniformly shallow with depths of less than 12 feet predominating. One bridge crosses the dredged channel at the entrance to Tampa Bay. Called the Sunshine Skyway, it is a land-filled causeway for most of its length, but becomes an 800-foot fixed span over the main ship channel with clearances of 149 feet at the center and 140 feet at the fenders. Originally constructed as a twin span bridge, it was reduced to a single span after the westward structure was downed when struck by a ship during a storm.

Tampa Bay offers little shelter from heavy weather. The generally low elevations afford only limited protection from strong winds. The configuration of the bay makes it most vulnerable to winds from the south or southwest, but the area is liable to the effects of wind from any direction.

The Climatology

For the purposes of this study, any tropical cyclone approaching within 180 nautical miles of Tampa is considered to represent a threat to the port. Its west coast location is significant, since the coastline is nearly parallel to normal tropical cyclone tracks as they move more or less northward out of the tropics. Also its latitude of about 27.8°N is within the normal locus of tropical cyclone recurvature, which oscillates between 25°N and 35°N. Tropical cyclones tend to slow and intensify during recurvature, making their path and intensity difficult to forecast.

The hurricane season extends from late May through early November, but tropical cyclones occasionally occur outside this period, with Tampa recording storms in February and December. During a 109-year period (1871–1979) there were 171 tropical cyclones that met the 180 nautical mile threat criteria for Tampa; an average of nearly 1.6 per year.

The months of maximum threat in terms of frequency are September and October. Of the Tampa Bay storms causing sustained winds of 34 knots or more, 67% occurred in September and October. However four storms that caused winds of 50 knots or more occurred in June, August, September and October.

From February through June the primary threat is from storms that originate in the western Caribbean moving from east of Nicaragua northward across western Cuba to Tampa. By July and August the main threat has shifted and storms originate in the Lesser Antilles with an average track that progresses northwestward across Puerto Rico, the Bahama Islands, and the Florida Peninsula to Tampa. An extension of this same track originates in the Atlantic Ocean well east of the Bahamas and follows a westward course until it merges with the first track. September's track resembles the previous one, but a secondary track similar to the early season main average path may be used. From October through December there are three distinct paths that tropical cyclones tend to follow. The most prominent one originates near the Lesser Antilles and extends westward through the Caribbean, then northward across Cuba to Tampa. A second axis starts in the eastern Bahamas and extends west northwestward across Florida. The third track begins in the western Gulf of Campeche and extends northeastward across the Gulf of Mexico to Tampa.

Local Effects

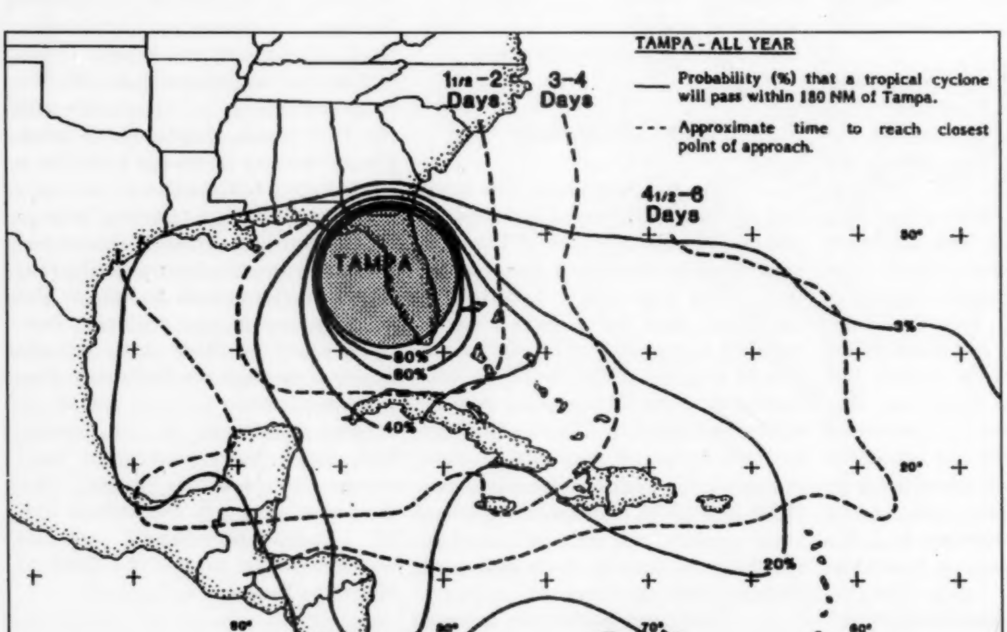
In the 48-year period for which wind records are available, some 75 tropical cyclones moved within 180 nautical miles of Tampa. Of the 59 tropical storms and hurricanes, 12 caused sustained winds of 34 knots or more in the Tampa area based on hourly wind observations. Four generated sustained winds of 50 knots or greater and one blew at sustained hurricane force (64 knots or more). Two of the remaining three did generate hurricane force wind gusts. This means, on the average, gale force winds can be expected from one out of every five tropical storms or hurricanes and hurricane force winds in one out of every 20.

Except for a small opening at its mouth, Tampa Bay is well protected from ocean wave activity. The opening, located between Egmont Key and Passage Key is about 1 1/2 miles wide with water depths of 20 to 25 feet. Large ocean waves moving in about a 060° direction, could move through this narrow passage, but most of the wave energy would be lost due to the shallow water and angular spreading on the east side of the passage. However, high winds from a storm could present a wind wave hazard to marine facilities around the bay. Maximum wind wave action would result from strong northeasterly or southwesterly winds.

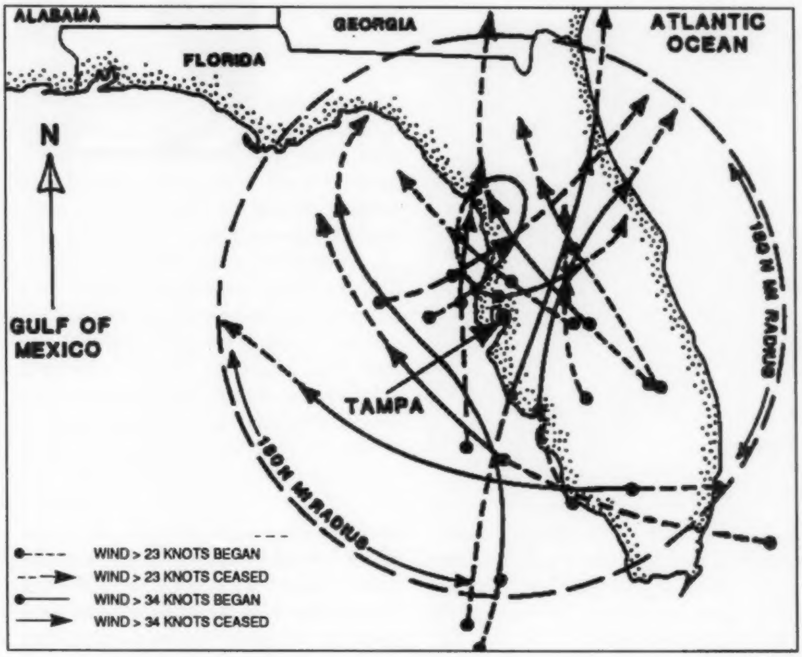
Storm tides can add to wave heights. They are worst when an intense storm is approaching perpendicular to the coast with the harbor within 30 nautical miles to the right of the storm track. A broad, shallow, slowly shoaling bottom and a coincidental high astronomical tide add to the hazard. The waters along the west coast of Florida meet the bathymetry criteria. This factor coupled with the characteristics of Tampa Bay, render it exceptionally vulnerable to storm surges. Tidal surges of 5 feet or more are common. Surges of devastating proportions, such as the 15 foot one in 1848 are possible. Also of significance is the record for October 18, 1910 when the water level at Hillsborough River fell 9 feet below Mean Low Water (MWL). A tropical storm passing to the east of Tampa while on a northward course, generated offshore winds that forced much of the water from the bay. The same effect was observed when Hurricane Betsy passed well south of Tampa on a westward course in 1965. According to local authorities "about a mile of shoreline" was exposed when Betsy passed.

The Decision

Tampa Bay is at considerable risk to damage primarily from a



Probability and Closest Point of Approach for all tropical cyclones passing within 180 nautical miles of Tampa (shaded circle), based on data from 1871–1979.



Track segments of tropical cyclones (1939–1979) that produced winds of 34 knots or more (solid lines) or 23 knots or more (dashed lines) at Tampa.

tropical cyclone storm surge and high winds. The absence of sheltered berths or anchorages makes evasion at sea the safest course of action for all seaworthy vessels as soon as it can be established that a particular tropical cyclone poses a threat to Tampa Bay. Early assessment of the threat potential is essential and should be related to the setting of hurricane conditions by military and civil authorities.

The greatest threats to Tampa are posed by tropical cyclones moving northward out of the western Caribbean Sea, or westward out of the Atlantic Ocean just north of the Greater Antilles, and which approach Tampa from the southeast, south or southwest. A greater threat of storm surge occurs when a storm approaches Tampa from the southwest quadrant and makes landfall within 100 miles north of Tampa Bay. A storm making landfall south of Tampa Bay with strong offshore winds could be expected to cause a lowering of the Tampa Bay water level.

As a general rule, any intense tropical storm or hurricane approaching from the Gulf of Mexico such that Tampa is located in the dangerous right front quadrant of the storm can result in severe wind and surge conditions. It must be remembered, however, that Tampa is vulnerable to storms from the east as well as the west.

Timing of the decision to evade is affected by:

(1) The forward speed of the tropical cyclone.

(2) The radius of hazardous winds and seas.

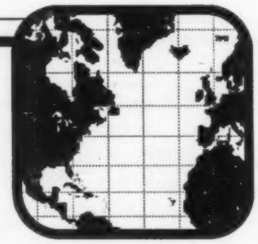
(3) The elapsed time to make preparation to get underway.

(4) The elapsed time to reach open water.

A worst case situation would be an intense tropical cyclone moving toward Tampa Bay from the southwest. Assume 6 hours are required to make preparations to get underway after the decision to evade is made. Approximately 3 to 4 hours are required to transit the channels leading to open sea. The storm approaching at an average speed of 10 knots will have closed 100 miles by the time sea room is attained. If the radius of strong winds likely to hamper port operations is 200 miles then the decision should be made about 30 hours before the expected time of arrival. It also should be remembered that the average tropical cyclone forecast error over a 48-hour period is about 200 nautical miles for those storms threatening Tampa.

A marginal threat situation, which includes situations when a storm is more than 48 hours away or when there is no established movement, may dictate a wait and see attitude. Remaining in port at Tampa is an option that should receive consideration in a secondary threat situation or when a ship is incapable of a successful evasion. Secondary threats include, storms developing within 180 nautical miles of Tampa or a tropical storm with winds of less than 48 knots, which is not forecast to intensify. Also secondary is a storm with winds greater than 47 knots but forecast to pass more than 100 miles from Tampa and the 50 knot winds not forecast to hit Tampa.

Much more detail, including evasion tactics, can be found in the *Hurricane Havens Handbook for the North Atlantic Ocean* by Roger Turpin and Samson Brand, June 1982, Naval Environmental Prediction Facility, Monterey, CA. Richard D. Gilmore of Ocean Data Systems helped prepare this Tampa Bay summary.



North Atlantic Weather Log July, August, and September 1989

July— The Azores–Bermuda High not only dominated most of the North Atlantic, as is normal, but pushed its way into the Norwegian and North Seas (fig 1). This created positive anomalies of up to 6 mb between Great Britain and Iceland, and also resulted in much above normal temperatures throughout the British Isles and Western Europe. The remnants of the normally weak Icelandic Low were found over Greenland replacing a weak high that usually develops. The low had organized not only into a center over Greenland but a trough which extended southwestward to the Grand Banks. All these features were reflected in the upper levels so that a weak gradient persisted south of 45°N while to the north a west southwest to east northeast flow was evident.

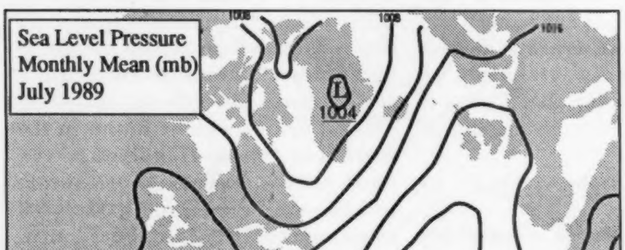


Figure 1.— The mean pressure chart for July shows the domination of the Azores–Bermuda High, which led to a heat wave in England and Western Europe. The Icelandic Low is perhaps the most unusual feature for this month.

On This Date

July 3, 1966— The northeastern U.S. was in the midst of a sweltering heat wave. The temperature on this date soared to 104°F in Philadelphia, PA.

Extratropical Cyclones

The Azores–Bermuda High, which was mostly composed of several intense, slow–moving anticyclones, kept the storm tracks confined to an average path that stretched from the mid–Atlantic U.S. Coast to the Denmark St. Overall, extratropical activity was light. Only one system was worth reporting.

❶ This system developed from a frontal wave that had formed well off the southeastern coast of the U.S. on the 1st. It headed northeastward and began to organize. By early on the 3d its central pressure was down to 970 mb as the system crossed the 40th parallel near 53°N. At 0600 the KNDB reported a 50–kn north northeasterly. The ***Atlantic Compass,*** close to the center, radioed a 979–mb pressure while battling a 70–kn wind. Although this wind seemed strong, it was not isolated. The ***Independent Spirit*** (44°N,47°W), battling 23–ft seas, hit a 60–kn southerly at 1200 on the 3d. This was evidently an intense, compact storm. At 1800 the ***Appleby*** and the ***Frithjof*** also reported 45–to 50–kn winds south of the center. The ***Junge Garde,*** at 0600 on the 4th, some 200 miles to the southwest of the center encountered 45–kn north northwesterlies. However, during the day the storm began to weaken as it continued northeastward.

Tropical Cyclones

Barry originated from a tropical wave which moved off the coast of Africa on July 7. By the 9th, a tropical depression had formed from this wave midway between Africa and the Lesser Antilles. The depression tracked northwestward, reaching tropical storm strength on the 11th. Barry's maximum winds were 39 kn and the minimum central pressure was 1010 mb. The storm weakened to a depression on the 13th and then dissipated into an elongated trough with several minor eddies. Barry's closest point of approach to land was about 550 mi northeast of the Leeward Islands.

Chantal was the first hurricane of the 1989 Atlantic season. The system that provided the embryo for Chantal first appeared on July 24 as an Intertropical Convergence Zone (ITCZ) disturbance near Trinidad, just off the coast of South America. The system moved westward across the Caribbean, with little development, until approaching Honduras on the 27th when some organization began to occur. However the Central American land mass interfered with the system as it crossed into the Gulf of Mexico.

Satellite pictures and ship data confirmed that a tropical depression formed on the morning of the 30th as the area of disturbed weather moved off the northwestern Yucatan Peninsula. The depression became Tropical Storm Chantal some 350 miles southeast of Galveston, TX, shortly after midnight on the 31st. Strengthening, Tropical Storm Chantal moved toward the northwest in the direction of the upper Texas coast at 10 kn. An Air Force reconnaissance plane found 80-kn winds at 1500 ft and Chantal was upgraded to a hurricane late on the afternoon of the 31st.

Hurricane Chantal made landfall near High Island, TX, during the morning of August 1st with top winds of 70 kn and a central pressure near 995 mb (fig 2). The center of Chantal continued moving northwestward and dissipated in southwestern Oklahoma after midnight on the 3d.

Figure 2.— Hurricane Chantal is ashore over the Houston, TX area at 1300, on the 1st of August, in this enhanced satellite view.

Rainfall associated with Chantal varied considerably. Houston's Hobby Airport reported 7.14 in. over 6 hr and 8.58 in. in 24 hr, whereas Houston Intercontinental Airport had only 2.05 in. in 24 hr. Unofficially, Friendwood, southeast of Hobby, recorded a storm total of 20 in. and Clear Lake, northeast of Alvin, had 16 in.

Thirteen deaths were attributed to Chantal and, just as in Allison, all were the result of drowning. The main effects from Chantal were from flooding by torrential rains and beach erosion. Total damage is estimated to be near $100 million.

The tropical wave that spawned **Dean** moved off the northwest coast of Africa on July 24 and became a depression on the 31st, midway between the Lesser Antilles and the Cape Verde Islands. The depression attained tropical storm strength by August 1, and moved toward the west northwest while continuing to strengthen. Dean was upgraded to a hurricane on the morning of the 2d, immediately after the first report of hurricane-force surface winds from an Air Force reconnaissance plane.

By the 3d, the hurricane decreased in forward motion and turned toward the northwest, in response to a collapsing ridge to the north and a developing upper-level trough off the U.S. East Coast. On the 4th Dean turned northward and accelerated toward Bermuda, bringing the eastern eyewall over the island near

midafternoon on the 6th. Highest reported, sustained winds were 70 kn with gusts to 100 kn at the U.S. Naval Annex on the western end of Bermuda.

The lowest pressure reported by reconnaissance aircraft was 970 mb, just after the hurricane passed Bermuda. However, after the last aircraft penetrated the cyclone, the cloud pattern observed in satellite imagery became even better organized with a well-defined eye embedded within a small but cold central dense overcast. Based on satellite estimates, the minimum pressure (968 mb) and maximum winds (90 kn) most likely occurred on the evening of the 6th.

After passing Bermuda, Dean turned and accelerated toward the northeast. The cyclone passed over Sable Island, Nova Scotia producing sustained winds of 66 kn with gusts to 77 kn. Dean then began to slowly lose tropical characteristics as it moved over southeastern Newfoundland. The cyclone became extratropical over the North Atlantic while moving toward the northeast at about 45 kn.

There were no reported deaths due to Hurricane Dean. Since the hurricane veered away from the northeast Caribbean, no significant damage was reported from the Leeward or Virgin Islands. Personal injuries reported on Bermuda totalled 16 and damage estimates were near $9 million.

Casualties

The *Avco V* capsized while heading for shore, along the Louisiana coast on the 31st, in the early squalls from Hurricane Chantal. Waves during the day were reported at 8 to 12 ft. The crew of 10 were believed trapped inside. At last report four bodies had been found. A second vessel the *Gulf Island IV* had also tipped over on the 31st about 15 mi east of Grande Isle. She had been evacuated after she began to list.

August— Shocking is the only way to describe the mean pressure chart for the North Atlantic this month (fig 3). A midsummer Azores–Bermuda High and an early winter Icelandic Low combined to produce this situation. Negative anomalies abounded— up to 10 mb around Iceland. This reflected the increased storm activity between Great Britain and Greenland, including a few storms that were more intense than normal, thanks, in part, to the extratropical remnants from several tropical cyclones. Another interesting feature is that this concentration of activity did not seem to be abetted by the upper level flow which was, in general, zonal in nature.

On This Date

August 17, 1969— Twenty years ago Hurricane Camille smashed the Mississippi Coast to become one of the worst storms in U.S. History. Winds gusted to 172 mph at Main Pass Block, LA and 190 mph near Bay St. Louis, MS. The hurricane claimed 256 lives and caused an estimated $1.3 Billion damage. Several days later the remnants of Camille caused flooding in Virginia, which killed an additional 113 people.

Extratropical Cyclones

Many of the storms bunched in the Iceland region this month came from the southwest. Other active areas included the Gulf of St. Lawrence and the Davis St.

❶ The extratropical remnants of Hurricane Dean created some problems over the northern North Atlantic. After Dean crossed Nova Scotia on the 8th, it began to turn extratropical and weaken. It looked like the end, but an infusion from several extratropical centers nearby gave it renewed life. By the 10th a 976–mb Low was threatening the northern shipping lanes. At 1800 on the 10th, the ***Appleby*** (57°N,11°W) recorded a 982–mb pressure in 44–kn southerlies, while the DBJF (66°N,30°W) encountered 40–kn northeasterlies. At 0000 on the 11th the ***Norna*** was battling 13–ft seas in 42–kn winds, some 300 mi southeast of the center; she also recorded a 985–mb pressure, as the storm's 978–mb center was beginning to turn a broad counterclockwise loop across southern Iceland. Pressure fell to 974 mb on the 12th and the storm remained potent until merging with storm No. 2 on the 14th.

❷ This system began on the 11th, just east of Southampton Is in northern Hudson Bay. That day and the next it swung southeastward across Quebec Province and Labrador maintaining a central pressure of about 1010 mb but not much organization. However, once into the friendly waters of the northern North Atlantic the system began to get it together. By the 14th the rapidly developing and rapidly moving storm was crossing the 55th parallel near 20°W as a potent 976–mb Low. And it was also absorbing the still powerful storm No. 1 into its circulation. At 1200 on the 14th the ***Ernst Moritz Arndt*** (47°N,27°W) picked up 40–kn westerlies while battling 20–ft seas. The ***Franconia*** (46°N,32°W) ran into 50–kn winds in 13–ft seas. By late in the day everyone was getting in on the act. Winds reports varied from 40 to 58 kn with seas in the 12–to 16–ft range. Some of the reporting vessels included the ***Kegums, Deppe America, Mormac Sun, Margit Gorthon, Ael Europa*** and the ***Arctic***. The gale reports continued through the 15th and 16th as the storm made its way northward. By the 17th the system began to fill and weaken as it made its way through the Greenland Sea.

Monster of the Month

⓫ While all the action was taking place in the northern North Atlantic, another Icelandic–bound system was coming to life, just east of Lake Superior, on the 14th. This started in a trough of low pressure that extended southwestward from Hudson Bay. The weak center paralleled the St Lawrence Seaway on the 15th. The following day it became a little better organized as it turned eastward into the Gulf of St Lawrence. However the central pressure was still a paltry 1003 mb, on the 17th, as the center moved across Newfoundland. Actually, even on the 18th it would be hard to pick this center out of a crowd of weak centers that stretched from Newfoundland to northern Norway. But what a difference a day makes. By 1200 on the 19th this system, with a little help from its friends, organized into a dangerous 972–mb Low, centered near 53°N,35°W and was poised to swing northeastward to become part of the legendary summertime Icelandic Low. The storm's harbinger was the ***Margit Gorthon*** (45°N,35°W), at 0600 on the 19th, which reported in with 58–kn southwesterlies in 12–ft seas. A few hours later the ***Stuttgart Express*** and the ***Ael Europa*** were encountering 40–to 45–kn winds in 13–to 16–ft seas. However, the ***Margit Gorthon*** continued to encounter the 58–kn winds and this was confirmed when ***OSV C*** ran into 54–kn winds while holding her position near 53°N,36°W at 1500; she was also battling 20–ft seas and recorded a 985–mb pressure. The following hour wind conditions abated somewhat as her winds dropped to 50 kn but seas increased to 23 ft. Meanwhile, the ***Margit Gorthon*** finally got some relief on the 20th, at 0000, when her winds dropped to 47 kn. The system then stalled near Iceland on the 21st. Although the track chart drops it at this point there is plenty of evidence to show that the storm remained an identifiable, nearly–stationary storm until the 24th. This persistence contributed significantly to the intensity of the climatic Low. More importantly, ships continued to encounter storm–force winds into the 22d.

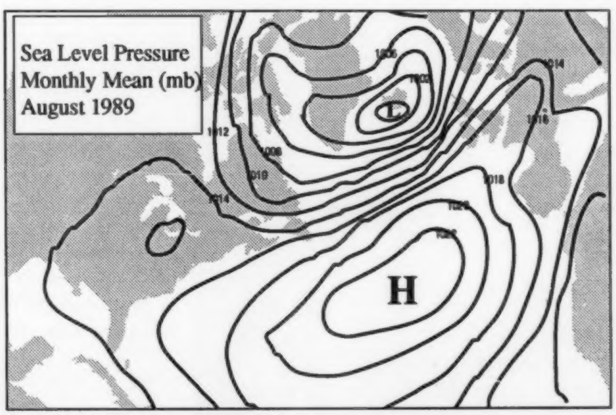


Figure 3.— The picture of the situation that rocked the climatological world. The Icelandic Low looks like an escaped fugitive from winter. How fragile the science is when a few potent storms can turn things upside down.

Tropical Cyclones

Erin got its start from a tropical wave that moved off the African coast on August 16. The wave developed into a tropical depression on the evening of the 17th while located just southeast of the Cape Verde Islands. Steering currents guided the developing depression toward the northwest and it became Tropical Storm Erin during the afternoon of the 18th.

A continued favorable environment elevated Erin to hurricane strength by the morning of the 22d. A short wave trough turned Erin toward the northeast the following day. The storm strengthened to a 968–mb hurricane with peak winds of 90 kn by the evening of the 24th (fig 4). It accelerated toward the northeast, weakened to tropical storm strength shortly after midnight on the 27th, and became extratropical a short time later.

Tenacity is the best word to describe **Felix**. Beginning as a tropical wave, which moved off the African coast on the 25th of August, it never had a chance to cross the tropical Atlantic and become a threat to the North American continent. However it persevered, mostly in the shadow of the much larger Gabrielle, to become the longest lasting tropical cyclone of the season.

After emerging from the African coast, Felix turned toward the northwest into a large trough which dominated the eastern Atlantic. From the 25th of August to the 5th of September, Felix strengthened to a storm, weakened to a depression, regained storm status and finally attained hurricane strength.

Based upon satellite imagery the hurricane's minimum central pressure of 979 mb, with top winds of 74 kn, occurred on the evening of the 5th. Even after becoming extratropical, 4 days later, Felix maintained its identity and became a large non–tropical storm

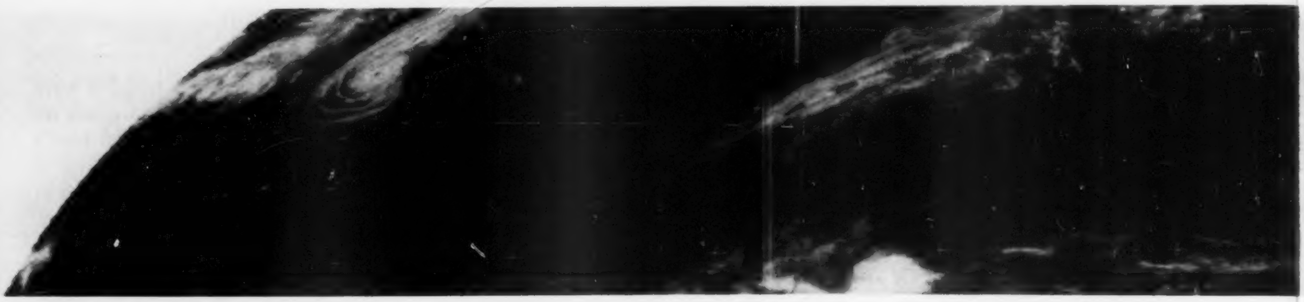


Figure 4.— Two for the price of one— Hurricane Erin can be seen to the left at peak intensity at about 1200 on the 24th, while it is just possible to make out the beginnings of Felix, before coming out of Africa, in the middle bottom of the photo.

off the coast of Spain.

Hurricane Gabrielle was a classic Cape–Verde–type tropical cyclone. It developed from an African wave near the Cape Verde Islands, tracked westward across the tropical Atlantic, while strengthening to a large category 4 hurricane, and made the typical parabolic recurvature into the northern North Atlantic.

The tropical wave, which became Gabrielle, moved off the coast of Africa on the 28th of August. After tracking west northwestward for several days, reconnaissance aircraft on the 31st found a category 4 hurricane, with a central pressure of 937 mb. Gabrielle's central pressure remained in the low 940–mb range for the next 3 days and maximum surface winds were estimated at 120 kn (fig 5).

Gabrielle moved toward the north during the next several days. It began to weaken on the 7th and, by the 10th, Tropical Storm Gabrielle became nearly stationary about 550 miles east southeast of Cape Cod, MA. The storm drifted slowly westward and weakened to a depression, on the 11th, but the following day Gabrielle accelerated toward the northeast and later merged with a developing North Atlantic storm off Newfoundland.

Surface hurricane–force winds frequently extended outward from the hurricane's center in excess of 100 mi and 100–kn winds, at flight level, occasionally extended outward to near 100 mi.

Gabrielle's powerful winds covered a very large area of the ocean and generated large ocean swells, which pounded the shores of the northeastern Caribbean Islands as well as Bermuda and the North American mainland from central Florida to the Canadian Maritimes. Swells ranged from 10 to 15 feet along portions of the U.S. east coast and were as high as 20 to 30 feet along the south coast of Nova Scotia. The large swells from Hurricane Gabrielle were responsible for eight deaths along the mid–Atlantic and New England coasts.

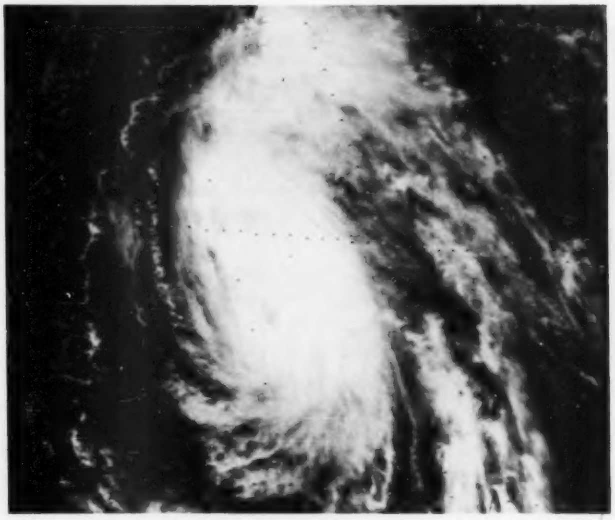


Figure 5.—Hurricane Gabrielle is seen in all its glory at about 1500 on the 4th of September. Winds were estimated at 120 kn. Gabrielle was a very large hurricane. The eye diameter never decreased to less than 20 mi and the majority of the time, while the hurricane was most intense, the eye diameter ranged from 45 to 55 mi.

Casualties

During the night of the 27th–28th a heavy storm damaged yachts in all the sailing harbors on the Schleswig–Holstein coast of West Germany, between Kiel and Lubeck. In the Wendtorf Marina, close to Kiel, about 600 yachts were damaged or sunk.

September— The beginning of the transition from summer to winter is usually marked by the appearance of the Icelandic Low. Considering this past August, its appearance was anticlimactic. However it was broader than normal (fig 6), resulting in an area of negative anomalies north of about 60°N. All was well with the Azores–Bermuda High, which, in fact, was stronger than normal around the edges. In the upper levels of the atmosphere the steering currents, north of 45°N, were zonal west of about 45°W, where they then curved toward the east northeast.

On This Date

September 8, 1900— The greatest weather disaster in U.S. history occurred when a hurricane struck Galveston, TX. A 5–ft wall of water swept over the island demolishing buildings and drowning more than 6,000 people. More than 3,600 houses were destroyed.

Extratropical Cyclones

Cyclone activity was concentrated in the Davis and Denmark Straits but several of the month's strongest storms made their way between the British Isles and Iceland, disrupting shipping over the northern routes.

❶ On the 12th and 13th, former hurricane Gabrielle merged with a developing Low off Newfoundland. At 0000 on the 14th, the VEDT (45°N,66°W) reported 40–kn south southwesterlies. This was typical of reports on the 15th as well. At 1000 on the 15th ***OSV L*** (57°N,20°W) encountered a 42–kn north northwesterly and measured a 976–mb pressure. This was near the storm's center and gave a good indication of its intensification. The central pressure had dropped from an estimated 989 mb at 1200 on the 14th to 965 mb 24 hr later. At 1800 on the 15th the TEXP (60°N,8°W) measured 975 mb in 44–kn winds while ***OSV L*** was estimating seas up to 23 ft around that time. The ***Johan Petersen***, at 1500, came in with 52–kn east southeasterlies in 23–ft seas with a 976–mb reading near 60°N,10°W. These vessels were providing a very accurate picture of the storm. At 0000 on the 16th, the ***Disarfell*** (60°N,11°W) topped everyone with a 60–kn south southwesterly and a 955–mb reading. The pressure seems a little on the low side in comparing it with all the others; at 0600 the ***Disarfell*** did report a 976–mb reading, so it might have been a transmission error. But her winds remained at 60 kn. In an area from 60° to 62°N between 7° and 10°W the ***Grundarfoss, Johan Petersen*** and XPRT were reporting 52–kn winds with pressures ranging from 971 to 984 mb. This continued through 16th, although at 1800 the XPRT reported that her winds had jumped to 60 kn. At the same time the UHIK (62°N,10°W) indicated a 966–mb pressure in 52–kn winds. Storm force winds continued into the 17th as the storm passed Iceland. As it began to fill, another behind it began to take up the slack.

❷ This storm formed in the wake of the previous one, in fact, along its front. It developed explosively on the 17th when central pressure fell to 962 mb— a drop of about 27 mb in 24 hr. There were no lack of reports as the storm was near the major shipping lanes at the time. Winds ranged from 45 to 60 kn while seas of 15 to 30 ft were common. Reporting vessels included the ***Independent Spirit, Nedlloyd Hudson*** and the ***Golden Fleece.*** On the 18th the northeastward–moving storm had crossed the 55th parallel near 24°W. At 1200 the ***Independent Spirit, Golden Fleece*** and ***OSV C*** all reported winds in the 40–to 45–kn range indicating a slight weakening of the storm. However central pressure remained at 972 mb on the 18th and 19th and vessels such as the ***Norna*** and ***Polyarnyy Zori*** indicated that winds were indeed in the 40–to 45–kn range. While this system remained strong into the 19th, it was eventually absorbed by another system.

❸ This intense Low was brought to the northern shipping lanes courtesy of Hurricane Hugo. After devastating coastal South Carolina on the 22d, Hugo recurved and moved along the Appalachian Mountains. On the 24th its extratropical remains made it into the friendly waters of the North Atlantic via Labrador. The extratropical system began to deepen and, by the

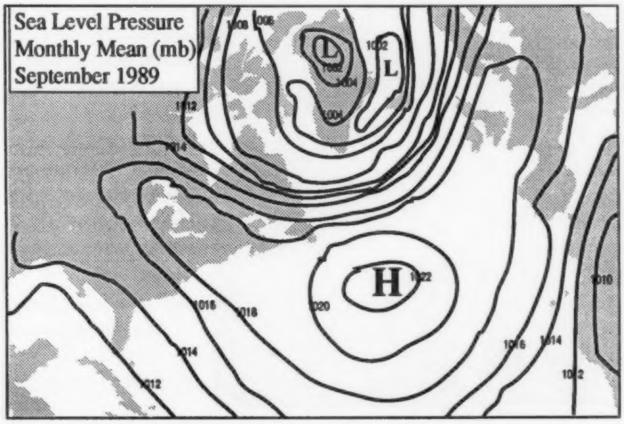


Figure 6.— The appearance of the Icelandic Low, after the sneak preview in August, was anticlimactic or maybe it would be more appropriate to say anticlimatic.

25th, it was barreling northeastward toward the Denmark St, sporting a 980–mb pressure center. At 0000, on the 25th, near 49°N,64°W, the ***Cabot*** ran into a 40–kn westerly as did the CGGN some 12 hr later. By 1200 on the 26th, central pressure was down to about 964 mb and the ***Johan Petersen*** (61°N,33°W) came in with a 52–kn southwesterly in 25–ft seas and a 969–mb pressure; an excellent report. At 0600 the OUNM2 had run into a 60–kn westerly in 20–ft seas. In general winds were being reported at 40 to 45 kn by such vessels as the ***Professor Zubov***, OUEK,Y4CG, OSVM, OUEN and the ***Valur***. The system remained potent into the 27th as it moved through the Norwegian Sea and away from the major ship traffic.

Tropical Cyclones

Hugo was another classic Cape Verde-type hurricane that cut a path of devastation across the Leeward Islands, the Virgin Islands, Puerto Rico and South and North Carolina.

The origin of Hugo was detected on satellite imagery on the 9th of September when a cluster of thunderstorms moved off the coast of Africa. A tropical depression formed to the southeast of the Cape Verde Islands and moved westward at 15 kn, becoming a tropical storm on the 11th and a hurricane on the 13th, while located about 1250 mi east of the Leeward Islands.

Both Air Force and NOAA reconnaissance aircraft reached the hurricane on the 15th, several hundred miles east of the Leeward Islands and reported a central pressure of 918 mb, a wind speed of 165 kn at an altitude of 1500 feet and a surface wind speed of 122 kn (fig 7). This was Hugo's maximum intensity and classified the hurricane as a category 5.

Hugo continued toward the west northwest and crossed the island of Guadeloupe shortly after midnight on the 17th. Just before Hugo's eye crossed over Guadeloupe, an aircraft reported 135–kn winds at 700 mb and the surface winds were estimated to be near 120 kn. The eye moved over St Croix 24 hr later, on the 18th, with maximum surface winds remaining near 120 kn.

The hurricane then began to accelerate and the eye moved over the island of Vieques, Puerto Rico just after sunrise and then over the extreme eastern tip of mainland Puerto Rico by midmorning on the 18th. Maximum winds at this time were estimated to be near 110 kn. Lowest recorded surface pressure on the island was 946.1 mb at Roosevelt Roads.

Leaving the island of Puerto Rico, Hugo took aim at the South Carolina coast. Hugo's track curved gently to the northwest over the next few days as a low pressure center, over the southeast U.S., moved southwestward and altered the steering flow pattern. By the 21st, Hugo was centered a few hundred miles east of Florida and began a gradual turn and acceleration toward the north in response to the steering flow associated with a major extratropical low that was advancing eastward across the central U. S .

The final landfall was made on the South Carolina coast, near Charleston, at Sullivans Island close to midnight on the 21st, with the eye moving northwestward at 20 kn. Just before landfall, a reconnaissance aircraft measurement of 934 mb and 140–kn winds at an altitude of 12,000 feet were the basis of the estimated 120–kn surface wind at landfall. A report of 76–kn winds with a gust to 94 kn was received from downtown Charleston. However the strongest winds associated with the hurricane probably occurred 10 miles

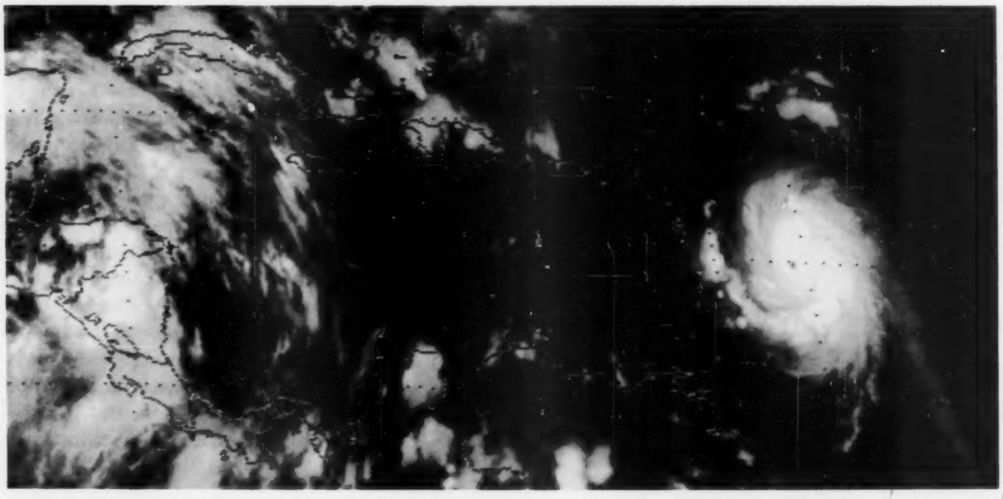


Figure 7.— Here's Hugo— near time of its peak intensity at about 2230 on the 15th. Surface winds were estimated at 122 kn. Hugo is approaching the Leeward Islands and soon to pass over Guadeloupe and St. Croix.

or so to the north of Charleston near Bulls Bay. Strongest measured sustained surface winds were 100 kn from the ship ***Snow Goose*** which was anchored in the Sampit River 5, miles west of Georgetown.

Moving inland and weakening, the center passed between Columbia and Shaw Air Force Base prior to sunrise on the 22d, when the air base reported a wind of 58 kn with a gust to 95 kn. By sunrise, Hugo had weakened to a tropical storm and passed just west of Charlotte, NC with winds of 60 kn and gusts to 87 kn. Hickory reported gusts to near 70 kn as the weakening storm passed over the town.

The storm moved northward across extreme western Virginia, West Virginia, eastern Ohio to near Erie, Pennsylvania by the evening of the 22d and transformed into an extratropical storm. The system was tracked for 2 more days as it moved northeastward across eastern Canada and into the far North Atlantic Ocean.

Storm tides along the South Carolina coast ranged from 8 to 10 ft in the Charleston–Folly Beach area to near 20 ft in the south end of Bulls Bay and down to 7 ft at Winyah Bay. As far north as Hatteras, NC, the storm surge was reported at 4 ft above the predicted tide.

Rainfall totals along the southeast U.S. coast ranged from a trace at Jacksonville to a maximum of 8.10 in. at Mt. Pleasant, near Charleston, to 0.58 in. at Hatteras. A 150–mile wide swath of 3 to 8 in. of rain spread inland across South Carolina. The swath continued over western North Carolina with a maximum of 6.91 in. reported at Boone. Rainfall totals were in the 2–to 4–in. range across western Virginia, West Virginia, western Pennsylvania, eastern Ohio and western New York.

The total number of deaths associated with Hugo is currently estimated at 49.

Damage figures are astronomical and Hugo is the costliest hurricane in U.S. history. Estimates total near the $10 billion mark with $7 billion occurring on the U.S. mainland.

The tropical wave that spawned **Tropical Storm Iris** moved off the northwest coast of Africa on September 12, immediately behind the wave that spawned Hurricane Hugo. The wave moved westward and became a tropical depression in the wake of Hugo, which was then approaching the Lesser Antilles on the afternoon of the 16th.

The tropical depression continued to develop and reached tropical storm strength on the evening of the 17th, while located about 450 mi east of Barbados. For the next 24 hr Iris persisted on a general northwesterly track under strong shearing from the outflow of Hugo. Air Force reconnaissance reports on the afternoon of the 19th, when the center was 275 mi northeast of Antigua, indicated that the maximum flight level winds at 1500 ft were 70 kn and the sea level pressure was 1001 mb. The reconnaissance aircraft estimated the surface winds were near hurricane force. Satellite estimated winds were near 45 kn at this time and in much better agreement with the pressure/wind relationship. Thus, it is concluded that Iris probably was just below hurricane strength at that time.

As Hugo moved away from the influence of Puerto Rico and Hispaniola, it strengthened increasing the shear over Iris. Thus, the strengthening of Iris was short-lived and it weakened rapidly thereafter while following in the wake of Hugo. Iris' center was completely exposed the next day as a result of Hugo's outflow shearing away the convection. Iris weakened to a tropical depression 275 mi northeast of San Juan, Puerto Rico by the evening of the 20th and dissipated about 225 mi east northeast of Turks Island by the evening of the 21st.

Casualties

On the 22d, off the Gower Peninsula, Wales the ***New Venture*** (40 ft) was towing the ***Seeker*** with three people onboard. They were experiencing strong gales at the time and the towline kept parting. The ***Seeker*** broached–to in heavy surf near the rocks but all three crewmen were rescued from the sea by RAF helicopter.

There was a report that the ***Queen Elizabeth 2*** had suffered some damage during Hurricane Hugo. The U.S. Navy guided–missle frigate ***Downes*** was damaged by a barge, which broke free and sank several small boats at Charleston Naval Base during Hugo. Also caused by Hugo: the 110–ft ***Midnight Star*** was driven aground in Fat Hog's Bay, Totola; the 90–ft ferry ***Voyager Eagle*** was hard aground in Road Harbor, British Virgin Islands; the ***Golden Spirit***, a 50–ft luxury catamaran was aground on a reef in Leinster Bay, Saint John, U.S. Virgin Islands, with only slight damage. Of course, hundreds of small and medium–sized boats suffered varying degrees of damage along the South Carolina coast during the storm.

Unless otherwise stated all times are Universal (UTC). All miles (mi) should be considered nautical miles. The number next to the storm summary corresponds to the same number on the track chart. The Monster of the Month is a title given to a storm that has been particularly hazardous to shipping. The tropical cyclone summaries are preliminary and are based upon information provided by the National Hurricane Center, Joint Typhoon Warning Center, Central Pacific Hurricane Center, and the Hong Kong Royal Observatory.

North Pacific Weather Log July, August, and September 1989

July— The subtropical high was right on target for the month (fig 1) and even stronger than normal. This resulted in positive anomalies of 2 to 4 mb over much of the central North Pacific. In addition, the high extended farther west than normal and positive anomalies over the western waters off Japan ranged from 4 to 6 mb. Pressures were slightly below normal in the western Bering Sea and the northeastern North Pacific.

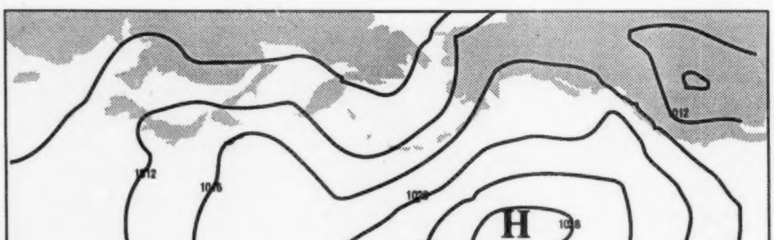


Figure 1.— This chart shows a good example of ridging, associated with high pressure, over Japan and troughing, associated with low pressure, in the Bering Sea. These features appear frequently on daily synoptic charts as well.

On This Date

July 10, 1871— The U.S.S. ***Jamestown***, on arriving Honolulu on the 5th of August, filed the following report. She was at sea for 63 days searching for reported "Islands" and "Dangers" east of 180 and north of about 24°N.

"The only interruption to very fine weather was a moderate gale on the 10th of July, which came on during the morning with heavy rain, squalls, and falling barometer with a moderate, broken sea. During the day wind backed from the N.W. around by W and S to S.E. and S in the evening... At sunset the storm cloud was plainly visible to the West, and moving away with accompanying lightning and rain. A gale was plotted, moving W by N at a rate of about 15 m.p.h. its centre probably passing within 200 miles of the ship."

Extratropical Cyclones

❶ This system came to life off Hokkaido on the 10th. It was just one of a series of atmospheric waves that had formed along a front, which stretched from mainland China to Vancouver Is. This one made it all the way across. At first it moved west northwestward across the southern Bering Sea while its central pressure ranged between 996 and 1000 mb. On the 14th it was moving through Bristol Bay on its way to a slow death over the Alaska Range when it suddenly shifted gears and turned toward the southeast. This brought new life and the storm deepened to 988 mb by the 15th. At 0000 on the 16th, the ***Diana*** ran into 58–kn northwesterly winds about 120 mi west of the center. The ***Madame Butterfly***, a

little farther away, reported winds to the tune of 43-kn while battling 25-ft swells. The storm continued southeastward until the 18th when it slowed and made a U-turn toward the northwest. About this time the *Green Maya*, just northwest of the center, ran into 55-kn northerlies in 10-ft seas. The storm then began to fill as it made its way through the Alexandria Archipelago.

● This storm had its beginnings over the remote regions of eastern Siberia on the 28th. It moved southeastward into the Bering Sea and intensified. By the 29th its central pressure dropped to 984 mb. With the aid of another Low, and a potent 1036-mb High in the eastern North Pacific, a tight gradient was created, over the shipping lanes, south and southeast of the Alaska Peninsula. The *Spring Bob* (47°N, 165°W) ran into 48-kn winds, at 0000 on the 29th, in 33-ft swells. The *Century Highway No. 1* and the *Young Scope* were reporting 40-kn southerlies. However, while the High remained potent, the Low began to weaken as the month came to a close.

Figure 2.— The track of Typhoon Gordon, from the Royal Observatory in Hong Kong, is preliminary. Gordon was one of the most intense storms in the Hong Kong area in recent years.

Tropical Cyclones

Six tropical cyclones occurred over the western North Pacific and the South China Sea in July and two of these attained typhoon intensity. The eastern North Pacific saw two hurricanes and two tropical storms.

Faye formed about 450 mi east southeast of Manila on July 7. It moved westward at about 7 kn and intensified to a severe tropical storm on the afternoon of the 8th, some 195 mi northeast of Manila. Faye crossed northern Luzon that evening spreading heavy rain across 11 northern provinces. Faye weakened to a tropical storm before it entered the South China Sea early on the 9th. That evening it slowed down and turned west-northwestward. Most of the rainbands associated with Faye were confined to the southwest of its center. Faye made landfall over Hainan around midnight on the 10th. In Hainan, some tropical crops were ruined and telecommunications were also interrupted. Faye weakened to a tropical depression and passed about 11 mi south southwest of Haikou. It crossed Beibu Wan on the 11th and finally made landfall over northern Vietnam, about 92 mi east of Hanoi.

Gordon formed about 310 mi north northeast of Guam on the 11th of July. It became one of the most intense typhoons in the Hong Kong region in recent years. The lowest estimated central pressure was 905 mb and the highest maximum winds near the center were in excess of 110 kn. Initially, Gordon moved westward at about 12 kn. It then turned west southwestward and intensified, gradually, to a severe tropical storm by the 13th. Gordon attained typhoon intensity the following morning about 600 mi east northeast of Manila. It turned west northwestward toward northern Luzon (fig 2)and reached its maximum intensity on the morning of the 15th. Maintaining this intensity, it made landfall over northern Luzon during the early hours of the 16th. However, it weakened considerably over land with the estimated central pressure rising by 40 mb in 6 hr.

According to press reports, the death toll in the Philippines was 41 and 30 people were reported missing. Torrential rain resulted in flooding and landslides in northern Luzon. Power and communication cables were blown down and seven provinces were blacked out. Numerous houses, schools and bridges were destroyed. At least 100,000 people had to seek refuge in typhoon shelters.

Gordon entered the South China Sea at around midday on the 16th. It traversed the northern part of the South China Sea making landfall over the western coast of Guangdong on the afternoon of the 18th. It weak-

ened to a severe tropical storm over land. As Gordon moved farther inland, into Guangxi, it continued to weaken rapidly.

During the passage of Gordon, mean winds of gale force, and gusts reaching hurricane force, were recorded in the Hong Kong area. Gordon also brought abnormally high tides to the Pearl Estuary.

In Hong Kong an old woman was found dead in her flooded squatter hut at Tai O. In the same village nine senior residents had to be evacuated. In Macau about half of the territory was flooded and the electricity supply to several areas was cut off. Abnormally high tides occurred along the coast. About 80 mi of coastal dykes were destroyed and over 80,000 houses were damaged. The death toll was 17 and more than 100 people were injured in Guangdong. Yangjiang was the hardest hit area. Eight people were killed and 84 people were injured. Over 46,000 houses were destroyed or damaged, while 252 fishing boats capsized.

In Zhaoqing, eight people died, while Zhuhai reported one person drowned and hundreds of houses collapsed. In Zhongshan, about 860 mi of coastal dykes were destroyed, while Jiangmen reported two deaths with one person missing and about 90 houses destroyed or damaged.

Hope formed as a tropical depression, about 410 mi southeast of Okinawa, on the evening of the 16th. It moved northwestward and intensified to a severe tropical storm on the 18th. Hope entered the East China Sea that evening. Moving slowly and erratically on the 20th, the storm made landfall over Zhejiang early the next morning. It then weakened rapidly and finally dissipated inland, about 70 mi southeast of Hangzhou, on the 21st.

According to press reports, 122 people died, while 21 others were reported missing and 900 people were seriously injured. The damage was most severe in the city of Ninpo as Hope passed to its south. Near the shore, 18 boats sank, while 12 piers were damaged. In the northern part of the neighboring province of Fujian, heavy rain brought water levels in rivers above the warning marks. Widespread flooding occurred and over 4,000 houses were damaged. The death toll was 23 and 1,000 people were injured.

As Gordon was causing havoc over eastern China, **Irving** formed, in the South China Sea, about 190 mi west of Manila, early on the 21st of July. It developed into a tropical storm and followed a north northwestward track early on the 22d. It later intensified to a severe tropical storm. Irving passed about 38 mi south southwest of Xisha that same morning and weakened to a tropical storm by afternoon. Moving almost parallel to the Vietnam coast, Irving, made landfall, about 110 mi south of Hanoi, early on the 24th. It dissipated inland over Laos, about 100 mi west southwest of Hanoi, on the evening of the 24th.

According to press reports, 102 people died and 488 people were injured in Vietnam. Over 80,000 houses were damaged and 256 boats sunk.

Judy developed about 800 mi southeast of Okinawa on the 23d. It moved northward and attained typhoon intensity 2 days later. Judy gradually turned northwestward, crossing the southern part of Kyushu during the night of the 27th, and made landfall over the southern part of the Korean Peninsula on the afternoon of the 28th. By this time it had weakened to a severe tropical storm. Over land, it turned northward and dissipated on the 29th.

In Kyushu two people were killed and six others were injured. Rainstorms destroyed two houses, while nine others were damaged and another 86 were flooded. Twenty-five landslides also occurred and the electricity supply was interrupted. In Shikokou, three people died when their house was destroyed by fire.

In Korea Judy caused landslides and flooding. Twenty-five people died and four were reported missing. About 7,700 houses were flooded and 17,000 people were made homeless.

Tropical Storm Lola came to life at the end of the month and moved slowly, in the vicinity of the Ryukyu Islands, on the first two days of August. It took a northwesterly track on the evening of the 2d and moved across the East China Sea. Lola further intensified to a severe tropical storm the following day but weakened after making landfall, near Shanghai, on the 4th. Crossing Jiangsu Province, Lola finally dissipated about 40 mi west southwest of Hefei, in Anhui Province, on the 5th.

According to press reports, very high tides occurred along the coast where Lola made landfall. Zhejiang, Jiangsu and Anhui provinces were devastated by severe floods. About 300 houses were damaged.

Typhoon Mac developed, on the last day of the month, some 570 mi northeast of Guam. It moved north northwestward on August 2, turned southwestward the next day and became a typhoon that evening, about 600 mi south southeast of Tokyo. Big Mac turned northward on the evening of the 4th and then north northwestward the next day. It made landfall about 50 mi east of Tokyo, on the 6th, and weakened. After crossing Honshu, Mac entered the Sea of Japan the next day and finally dissipated, about 290 mi west northwest of Sapporo, on the 8th.

In Honshu heavy rains caused flooding and over 100 landslides in Fukushima and Miyagi prefectures. Twelve houses were destroyed and over 4,000 houses were flooded. Eight people were killed, seven were reported missing and fifteen people were

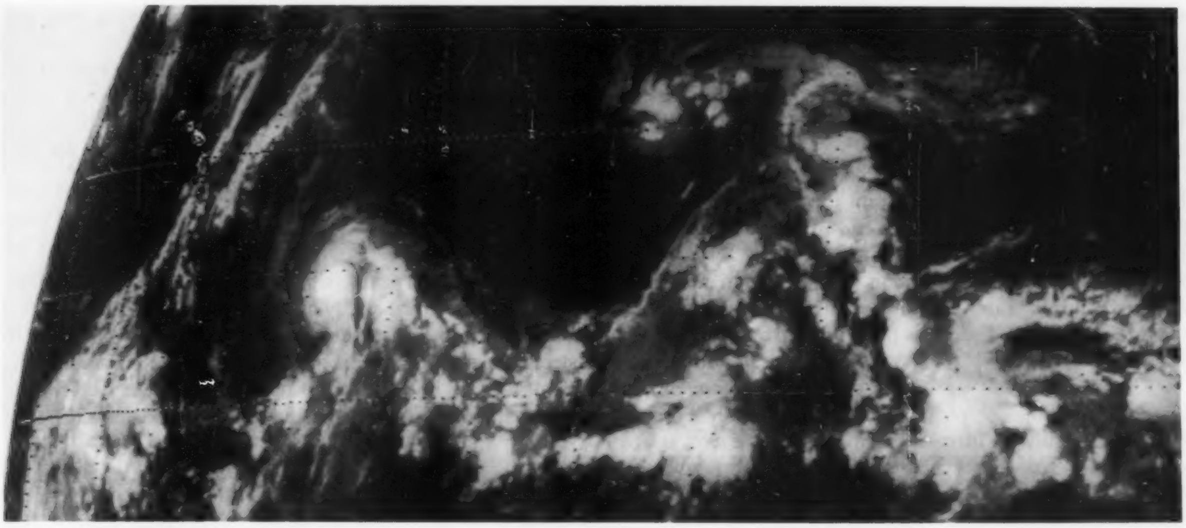


Figure 3.— An active Intertropical Convergence Zone (ITC) stretches across the eastern North Pacific, at about 1200, on the 17th. To the left is Hurricane Dalilia, which has just crossed in the Central North Pacific Hurricane Center's area of responsibility. The Hawaiian Is are located in the upper left.

injured.

Dalilia came to life on the 12th of July near 10°N, 109°W. Initially moving westward, it turned toward the west northwest on the 13th, reaching hurricane strength late in the day. By the 16th, the hurricane peaked when pressure dropped to 977 mb. Dalilia moved slowly westward, crossing into the Central Pacific Hurricane Center's (CPHC) area of responsibility at 0000 on the 17th (fig 3). Turning again toward the west northwest, the storm gradually increased its forward motion to near 20 kn and aimed itself at the Hawaiian Islands as a steady state hurricane with maximum sustained winds of 65 kn.

Wave energy, generated in the strong easterly winds north of the center, moved along with the storm at a rate of 20 knots. This resulted in a concentration of swells travelling in a narrow band along the direction of the storm motion, which caused 10–to 15–ft surf along the Puna and Kau coasts on the Big Island of Hawaii. These waves arrived slightly ahead of the weakening cyclone as it passed less than 100 mi to the south of South Point, Hawaii at about 0300 on the 20th.

Hurricane Dalilia was downgraded to a tropical storm at 1800 on the 19th. At 0600 on the 20th, the center of Dalilia was located by U.S. Air Force reconnaissance about 60 mi southwest of the Kau and South Kona coastlines, paralleling the Hawaiian Island chain. Winds gusted to 40 kn at South Point and other spots in the Kau and South Kona districts. Wind damage was minimal, mostly in the form of downed trees and power lines.

Rainfall was heavy over the southeast slopes of Mauna Loa, from South Point across the Volcano National Park, and into the Puna district, where 6 to 9 in. of rain fell during the night of the 19th. The other islands in the Hawaiian chain also received some heavy rains during the passage of Dalilia. These rains occurred mainly to the northeast of the center as the storm remained well offshore. Rainfall on Oahu, on the night of the 20th, totaled between 1.5 and 3 in., with some isolated accumulations of 5 to 8 in., along the foothills, from Waimea to Sunset Beach.

Dalilia weakened as it moved west northwestward, away from the main Hawaiian Islands group. The fast moving remnants of Tropical Storm Erick caught up to the dissipating circulation of Dalilia; the added moisture caused another burst of heavy rains, this time over the islands of Kauai and Niihau where 3 to 6 in. fell. Some amounts of more than 10 in. with localized flooding, were reported.

The remnants of Dalilia drifted west northwestward, along the Northwestern Hawaiian Islands (Nihoa to Kure Atoll), and dropped some unusually heavy summer rains over French Frigate Shoals and other islets. These heavy showers, plus the infusion of additional moisture from Erick, led to the warming of the circulation and it regained some of its tropical characteristics, on the 24th and 25th, as it approached Midway Island and Kure

Atoll. The rejuvenated cyclone may have reintensified into a tropical storm, for a short period of time, while recurving just east of Midway Island. On the 28th, the remnants accelerated northward toward the Aleutian Islands.

Tropical Storm Erick developed on the 19th, near 12°N,125°W. It headed northwestward and maximum winds reached 35 kn with a minimum pressure of 1005 mb. Erick's claim to fame was interacting with Dalilia as previously mentioned.

Flossie was another tropical storm that developed in July. It formed some 200 miles south southwest of Acapulco, on the 23d, and paralleled the Mexican coast for the next 5 days. It dissipated just west of the southern Tip of Baja California on the 28th. Flossie's maximum winds reached 35 kn.

Hurricane Gil sprang to life, on the 30th of July, about 180 mi south of Acapulco. Like Flossie, Gil headed northwestward. However, this time conditions were right for intensification and Gil reached hurricane strength on the 30th. By the 1st, central pressure dropped to 979 mb and winds climbed to 75 kn as Gil crossed 110°W near 19°N. However, once across the 20th parallel, in the eastern North Pacific, a hurricane's chances for survival drop dramatically, along with water temperatures. Gil lost hurricane strength on the 2d and dropped below tropical storm intensity the following day.

Casualties

The motor vessel *Maw-La-Myaing*, during her passage from Yokohama to Busan, suffered damage to her heavy-lift derrick and other equipment, on the 25th, while battling Typhoon Judy.

August— A stronger than normal subtropical high was centered slightly northeast of its normal spot, but bulged northwestward (fig 4) resulting in higher than normal pressure southeast of the Kamchatka Peninsula. Around the Alaska Peninsula was an area of negative anomalies of up to 4 mb. This was due to a low pressure trough, which extended from eastern Siberia across the Bering Sea. This trough was also apparent in the upper levels and resulted in steering currents, which were zonal west of 160°W but then turned cyclonically northeastward to the east, above 40°N.

On This Date

August 9, 1871— The Kohala Cyclone was reported in the *Hawaiian Gazette*, which gave, among other descriptions, this account by a resident of Maui: "It commenced yesterday morning before daybreak with a fine, steady rain accompanied by a rising wind from the North and Northeast increasing in violence until about noon, when the play was at its height, and coconuts, breadfruit, branches of trees and whole trees might be seen pirouetting and galloping down one street and up another, while the horrible roar of the gale, now shrieking like 5000 steam whistles let off at once, now becoming like magnificent thunder kept up with music to the mad performance."

Extratropical Cyclones

Although there were many extratropical systems during the month, few caused more than a brief problem to ships traversing the North Pacific. The main problems came from the tropical systems and some of their extratropical remnants.

❶ It wasn't until the 19th that a storm worthy of the name came along. This system sprung from the remnants of former Tropical Storm Owen, which turned extratropical near 50°N,155°E. Nearby, several ships were reporting winds in the 40-to 50-kn range with seas of 15 to 20 ft. At 0000 on the 19th these ships included the ***President Kennedy, Nade Ribakovayte, Hanjin Long Beach***, and the VPFZ. The system appeared to be weakening as it turned toward the east northeast. However, the pressure leveled off around 996 mb

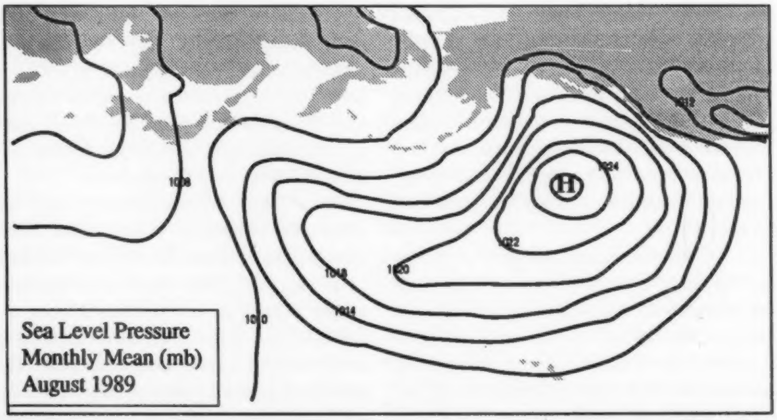


Figure 4.— The ridging that was seen over Japan in the July average pressure chart ,as well as the troughing over the Bering Sea, is still noticeable in August.

on the 20th and then the storm began to reorganize and deepen. The *Gissar*, close to the center, reported a 58-kn northerly on the 19th, at 1200, but that was the last report of storm force winds. By the 22d the center had deepened to 989 mb and the system was again becoming a threat. However, on the 24th it began to swing northeastward and the following day it crossed Bristol Bay and ended up over the Alaska mainland.

❾ This system sprang up on the 23d off Hokkaido, unassisted by a tropical cyclone. Moving east northeastward, it developed slowly. By the 25th, the 990-mb Low was heading toward the Bering Sea. At 0000 the *Jinkai Maru*, some 300 mi southwest of the center, was nailed by 40-kn west northwesterlies in 15-ft swells. By the 26th, at 1800, the central pressure had dropped to 980 mb. Six hr later a vessel reported a 52-kn wind in 13-ft swells and, at 0600 on the 27th, the *Hyundai No. 107* was battling 60-kn westerlies near 50°N,175°E. The storm ran aground near the previous storm's location on the 29th.

❿ The short-lived remnants of Tropical Storm Roger are worth a mention since they created a brief problem, in the northwestern waters, toward the end of the month. Roger turned extratropical on the 28th as it moved across northern Honshu and Hokkaido. By 1200 it sported a 984-mb pressure and, to the south, the *Vasily Blyukher, Zvezdnyy Bereg, Perouralsk,* and *Novaya Kakhovka* were reporting 40-to 50-kn winds in 12-to-15 kn swells. On the 29th the storm intensified and the *Akademik A Nesmeyanov* and the *Kuloy* reported 58-kn winds in different quadrants. In general, gales were the rule although the *Akademik A Nesmeyanov* picked up a 52-kn southwesterly at 1800. The storm began to weaken on the 30th and faded the following day along with August.

Tropical Cyclones

Three tropical storms formed over the western North Pacific in August. All developed near or north of 20°N. This was also the second consecutive year in which the South China Sea was devoid of tropical cyclones in August. The eastern North Pacific saw a total of six tropical cyclones (tropical storms and hurricanes) during August— three of these reached hurricane strength.

Nancy formed on the 12th of August and moved east southeastward. It then tracked north northwestward later in the day and intensified to a severe tropical storm the next morning. Turning northward on the 15th, the storm reached typhoon strength about 325 mi east of Tokyo. Nancy gradually weakened to a tropical storm as it passed to the eastern tip of Hokkaido, on the evening of the 16th, and became an extratropical storm over the Kuril Islands the next day.

Owen developed as a tropical depression, about 400 mi northeast of Guam, on the same day as Nancy. It moved southeastward but then turned toward the north on the evening of the 13th. Owen intensified to a severe tropical storm, about 650 mi northeast of Guam, the next day. It passed about 290 mi east southeast of Tokyo on the 17th. Owen then recurved northeastward and became an extratropical cyclone, about 100 mi south of Kamchatka, on the 19th.

Roger formed near the Ryukyu Islands on August 25. It was moving southeastward but turned northeastward the next day. Roger became a tropical storm, about 160 mi south southeast of Kagoshima, on the 26th and made landfall over Shikoku the following day. It continued northeastward across Honshu and Hokkaido. Roger finally dissipated about 290 mi north northeast of Sapporo early on the 29th.

As Roger's track was almost parallel to the Japanese Islands, the whole country was affected. According to press reports, torrential rain brought flooding and landslides. About 550 houses were flooded. Air traffic and rail services were paralyzed. Three people were killed while three were reported missing and another eleven were injured.

In the east, **Henriette** developed on the 14th near 12°N, 125°W. It moved northwestward for 4 days. Maximum winds reached 45 kn with a minimum central pressure of 1000 mb.

Hurricane Ismael also formed on the 14th but much farther east. It was discovered about 300 mi south southeast of Acapulco as a depression. After a brief northwestward journey, Ismael turned toward the west northwest on the 16th. The following day it became a hurricane. By the 19th Ismael reached peak intensity when 105-kn winds roared around a 955-mb center. This was by far the strongest storm of the season, in the eastern waters, up to this point. It maintained hurricane strength until the 23d. Ismael was a rapidly weakening tropical storm when it crossed into the central Pacific on August 25 at 0000. The Central Pacific Hurricane Center (CPHC) downgraded Ismael to a tropical depression with maximum sustained winds of 30 kn when it issued its first advisory. It continued to weaken as it moved westward at 10 kn.

Juliette and **Manuel** were the other tropical storms of August. Juliette came to life on the 21st and lasted for about 4 days. Maximum winds reached 55 kn. Manuel popped up on the 28th about 300 mi southwest of Acapulco. During its 4 day life, on a track that paralleled the Mexican coast, maximum winds reached 40 kn.

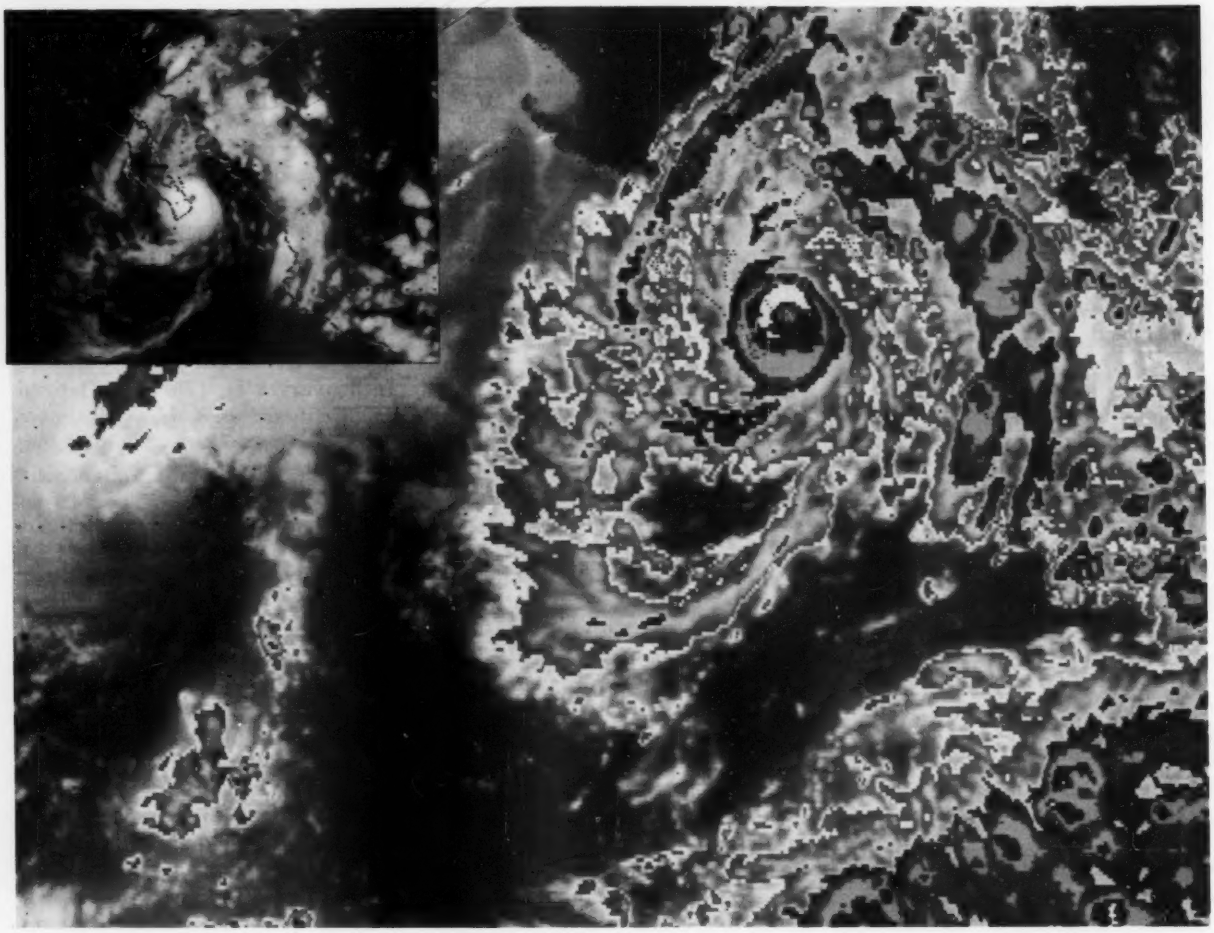


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Figure 6.—Hurricane Kiko developed in the Gulf of California and was able to generate 105–kn winds before slamming into Baja California on the 27th. The enhanced view of Kiko was taken at 0031 on the 27th. If you look closely, you can see the center is very close to land. The inset in the upper left shows the hurricane at the same time without enhancement and a very definitive eye.

Hurricane Kiko was another potent eastern North Pacific hurricane. Its maximum winds reached 105 kn, with a 955–mb pressure, just before it roared across the Baja on the 27th (fig 6). Kiko had an unusual origin. It came to life north of 20°N, in the Gulf of California, on the 25th. In addition to strong winds the hurricane brought torrential rains to southern Baja California. Upon emerging into the Pacific on the 28th, Kiko continued to weaken rapidly as it headed south.

While Kiko was blasting the Baja, **Hurricane Lorena** was coming to life some 300 mi southeast of Acapulco. The tropical depression moved northwestward and then gradually turned toward the west northwest. Lorena headed for trouble when it crossed the 20th parallel, on the 31st, near 113°W. Shortly after that it became a minimal hurricane as maximum winds climb to 64 kn and central pressure dropped to 989 mb. This only lasted for a few hours on the 1st of September and then the system was back to tropical storm strength and heading westward. The damage had been done and Lorena continued to dissipate over the next several days.

Casualties

There were no major shipping casualties reported in August.

September— The outstanding climatic features this month were the stronger-than-normal Aleutian Low and the double-centered subtropical high (fig 7). The Aleutian Low resulted in negative anomalies, of up to 6 mb over the southern Bering Sea, while the western center created +2mb anomalies off Japan. The low pressure in the Bering Sea was reflected in the upper levels as a trough centered near 170°W with some ridging over the eastern Pacific. The steering currents were nearly zonal over the western Pacific curving cyclonically at the dateline to become northeastward to the east of 165°W.

On This Date

September 16, 1967— Hurricane /Typhoon Sarah reached peak intensity with sustained surface winds at 120 kn. The storm engulfed Wake Is, where a 933-mb pressure was measured in the eye. Winds on the island were estimated at 130 kn after the wind equipment blew away. Waves crashed over the tiny outpost, which suffered extensive damage.

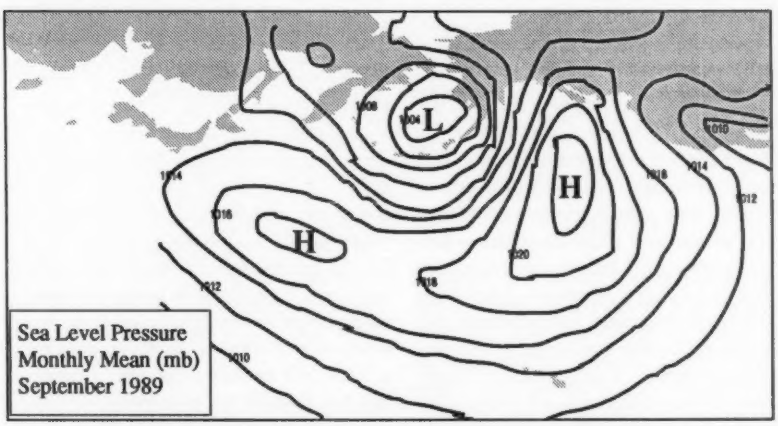

Figure 7.— The Pacific climatic chart for the month featured a fairly potent Aleutian Low with a double-centered subtropical high. Ridging and troughing are quite noticeable on this chart and the feature over the western U.S. is known as an inverted trough.

Extratropical Cyclones

Activity was confined mostly to the Bering Sea and even the extratropical portions of the tropical cyclones did not make much of an impression this month.

❶ This storm came to life on the 1st over the Sea of Okhotsk. It headed east northeastward and intensified slowly. However, by 1200 on the 3d it had dropped some 20 mb of pressure in 24 hr and the 972-mb storm was dominating the weather over the central North Pacific. At 1200 the *Skeena*, some 300 mi southeast of the center, ran into 40-kn southerlies in 10-ft swells. Winds of 40 to 45 kn were reported late in the day by the *Arco Sag River*, *Skaugran* and the *Bergen Arrow*, along with swells of 10 to 20 ft. Central pressure fell to 970 mb as the storm dipped southward, out of the Bering Sea and into the North Pacific, on the 4th. At 0000 the *Bergen Arrow* recorded a 969-mb pressure about 100 mi west of the center in 40-kn winds and 18-ft seas. At this time the *Pacemperor* was belted by 56-kn winds, while riding 13-ft swells, near 54°N,176°W. The 4th was a turbulent day but the storm began to fill rather quickly as it headed toward the southeast.

❷ This storm originated in the northern Sea of Okhotsk on the 16th. However it wasn't until the 19th, near 50°N,175°E, that it began to make a splash. By 1200 on that date, central pressure was down to 984 mb and the *Glory Express*, some 500 mi to the southwest, hit 35-kn northwesterlies. At 1200 on the 20th, the *Nichibu Maru* ran into 40-kn southerlies and measured a 988-mb pressure, some 200 mi southeast of the center. Six hr later the *McKinney Maersk* (48°N,170°W) turned in a report of 48-kn southerlies in 20-ft seas with a 978-mb pressure. On the 20th, the storm swung northeastward but remained potent with 40-to 45-kn winds; at 1200 on the 21st the central pressure was 974 mb. However, on the 22d it began to fill as it moved over Bristol Bay.

Tropical Cyclones

Six tropical cyclones occurred over the western North Pacific and the South China Sea in September. Two of them attained typhoon intensity. In the eastern waters there were four tropical cyclones, two of which became severe hurricanes.

Sarah formed, about 420 mi north of Guam, on September 6 and moved westward. It intensified to a tropical storm the next day, then turned southwestward, on the 8th, and slowed east of Luzon. Sarah then took a northward course, on the evening of the 9th, and attained typhoon intensity the next day (fig 8). It turned westward toward Taiwan on the 11th, making landfall about 100 mi south of Taipei that night. Sarah entered the East China Sea on the evening of the 12th and made landfall over Zhejiang the next afternoon. It dissipated inland soon afterward.
According to press reports, rain associated with Sarah triggered floods and

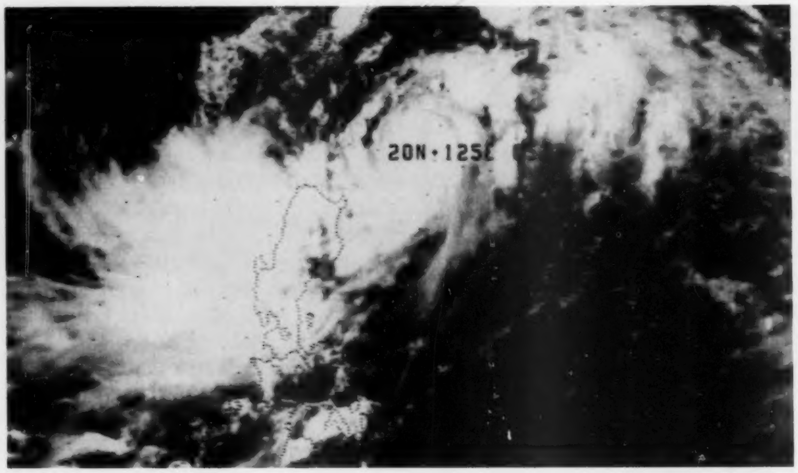

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Figure 8.— Typhoon Sarah is spotted heading toward Taiwan in this photo taken at about 1800 on the 10th. At this time Sarah was close to peak intensity.

landslides in the northern part of the Philippines, leaving 31 people dead. Over 200,000 people had to flee their homes. Three bridges were destroyed by rampaging waters.

In Taiwan 19 people were killed while 14 others were reported missing. The ***Lung Hao***, a freighter, broke in half after strong winds drove it away from Hualien Harbor. Landslides and flooding triggered by heavy rain, damaged bridges, roads and railways on the island. Electricity supply was interrupted and transportation paralyzed. Twenty–eight houses were destroyed and 41 houses were damaged. Total damage to agriculture and forestry was estimated at about $39 million (U.S.).

Tip formed, about 650 mi northeast of Guam, on the 9th of September and moved north northeastward at a speed of over 20 kn. Turning northwestward that evening, it intensified reaching tropical storm strength the next day. It then slowed down, on the afternoon of the 10th, and moved northward the following day. Tip then gradually turned eastward and weakened to an area of low pressure about 1200 mi east of Tokyo early on the 14th.

Vera came to life, about 280 mi north northwest of Guam, on the 12th. It quickly intensified to a tropical storm and moved steadily west northwestward. Vera reached severe tropical storm intensity on the 14th and entered the East China Sea the following day. It made landfall about 135 mi south southeast of Hangzhou, as a tropical storm, on the evening of the 15th. As Vera moved farther inland, it weakened to an area of low pressure, some 50 mi south of Hangzhou, early on the 16th.

According to press reports, the death toll in Zhejiang was 162 while 354 people were reported missing, 692 people were injured and hundreds of people were made homeless. Gale–force winds and rainstorms knocked down power and telephone lines and destroyed dykes and dams. About 46, 000 houses collapsed. In the scenic city of Hangzhou, the streets were flooded and hundreds of trees were blown down. The remnants of Vera also affected the coastal areas of Jiangsu.

Wayne formed near the Ryukyu Islands, about 185 mi southwest of Okinawa, early on the 18th and moved northward. It became a severe tropical storm that evening and turned northeastward. Wayne intensified into a typhoon on the 19th before crossing the southern tip of Kyushu early that afternoon. It then weakened to a severe tropical storm and accelerated northeastward. Wayne skirted the southern coast of Honshu early on the 20th and became part of an extratropical cyclone that afternoon.

In Japan, three people were killed and another reported missing according to press reports. Four houses and four bridges were damaged while 4, 000 houses were flooded. There were 166 reports of landslides in western Japan.

Angela developed as a tropical depression, about 240 mi north northeast of Yap Is, on the 29th of September and it was moving north northwestward at the end of the month.

Brian was the only tropical cyclone to occur in the South China Sea during the month. It formed about 160 mi south southeast of Hong Kong on the last day of the month and was almost stationary.

Narda and **Priscilla** were the tropical storms that formed in the eastern Pacific during September. Both developed within a few hundred miles of the Mexican coast, Narda southeast of Acapulco on the 3d and Priscilla off Manzanillo on the 21st. Narda moved toward the west northwest, reaching tropical storm strength on the 4th, and peaked the next day when winds climbed to 45 kn around a 1000–mb pressure center. Priscilla headed toward the northwest, at first, but then turned westward, on the 22d, after reaching tropical storm strength. Maximum intensity

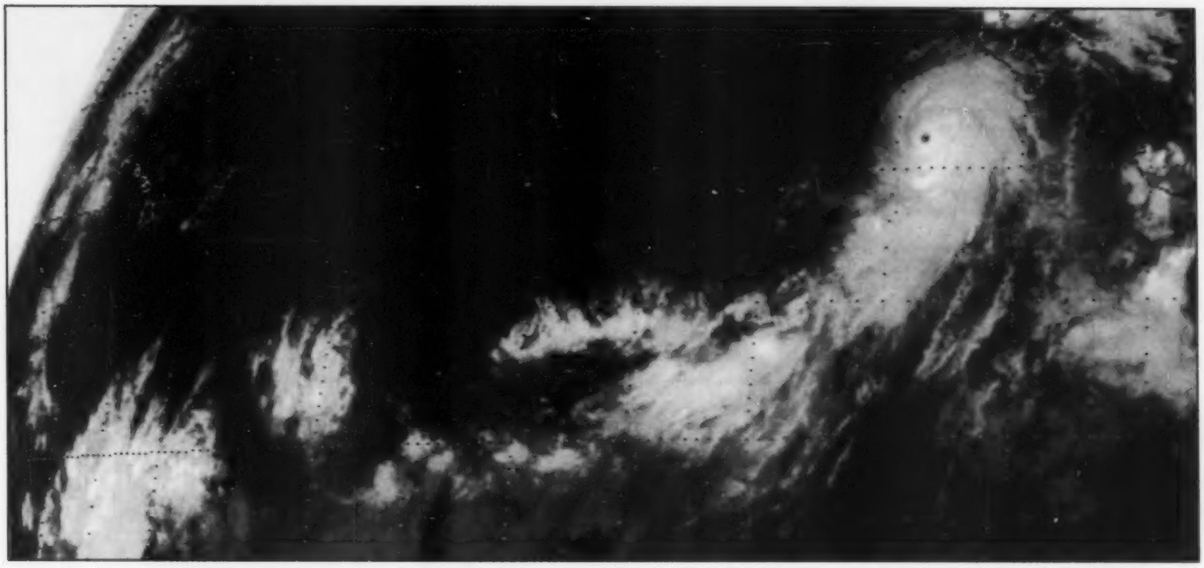


Figure 9.— Hurricane Octave was the second strongest storm in the eastern North Pacific during this season. It is seen here on the 13th at 0031 near peak intensity, when winds reached 110 kn and pressure fell to 948 mb.

occurred early on the 23d when winds hit 55 kn around a 993–mb center. However the storm began to weaken the following day.

Octave was first detected on the 8th, some 350 mi south of Acapulco. It headed northwestward and developed slowly over the next few days. Reaching tropical storm strength on the 10th and hurricane intensity late the following day, the hurricane turned toward the northwest. Even though it was heading toward certain death it continued to intensify. On the 13th, after crossing 20°N, Octave reached peak intensity. Winds rose to 110 kn around a 948–mb pressure (fig 9). Octave was able to maintain hurricane strength until the 14th when it began to recurve toward southern California and weaken rapidly.

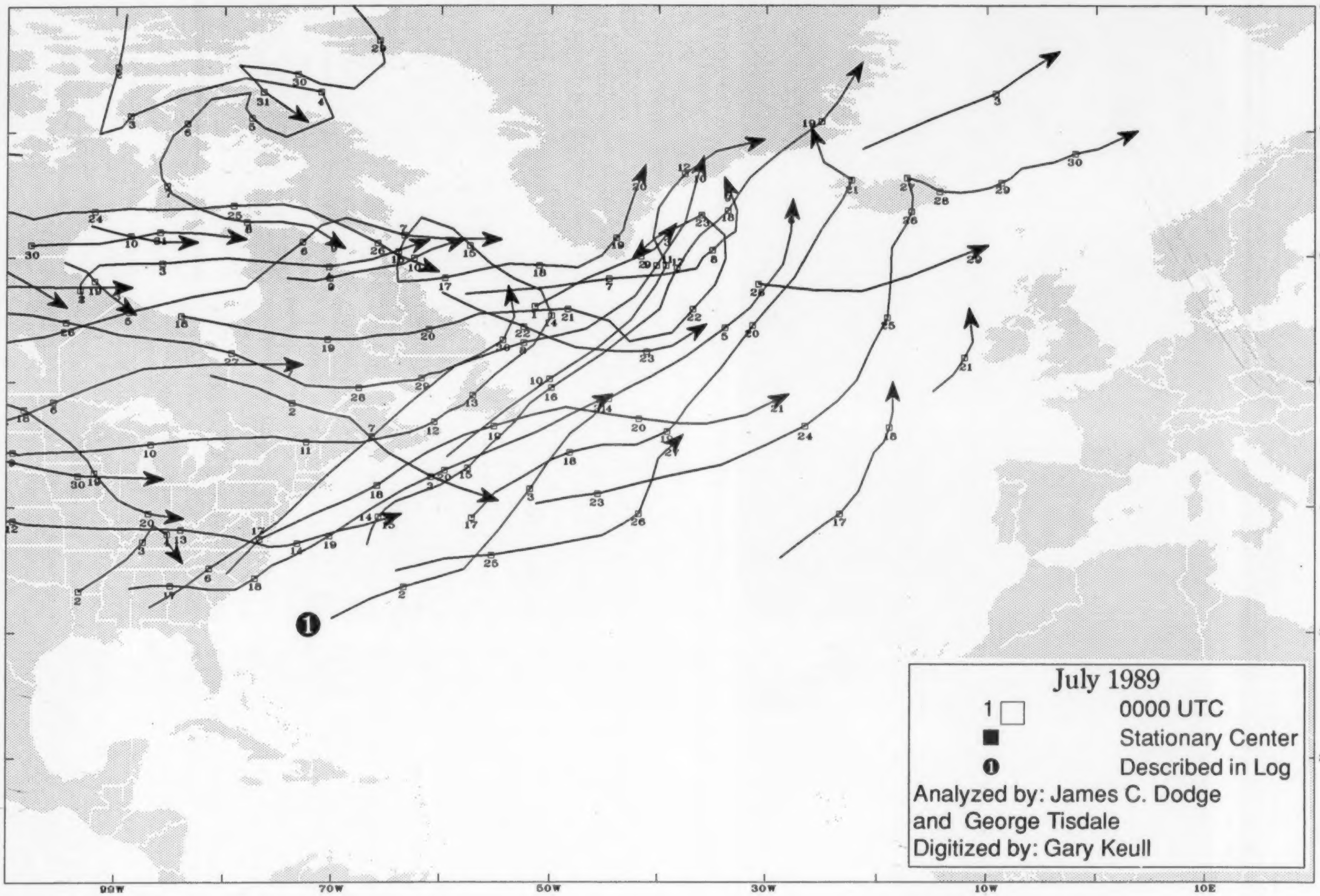
The strongest hurricane of the season was **Raymond,** the last one. Raymond's winds were estimated to have reached 125 kn on the 1st of October, while located a few hundred miles southwest of the southern tip of Baja California. Raymond recurved toward the northeast and moved across the central Baja and into western Mexico, but only after weakening to tropical storm strength. Raymond's rainfall over Mexico was light because of the storm's rapid movement. However flash flooding over southeastern Arizona was caused by Raymond's remnants, which dropped 2 to 5 in. of rain in this area and caused about $1.5 million in damages.

Casualties

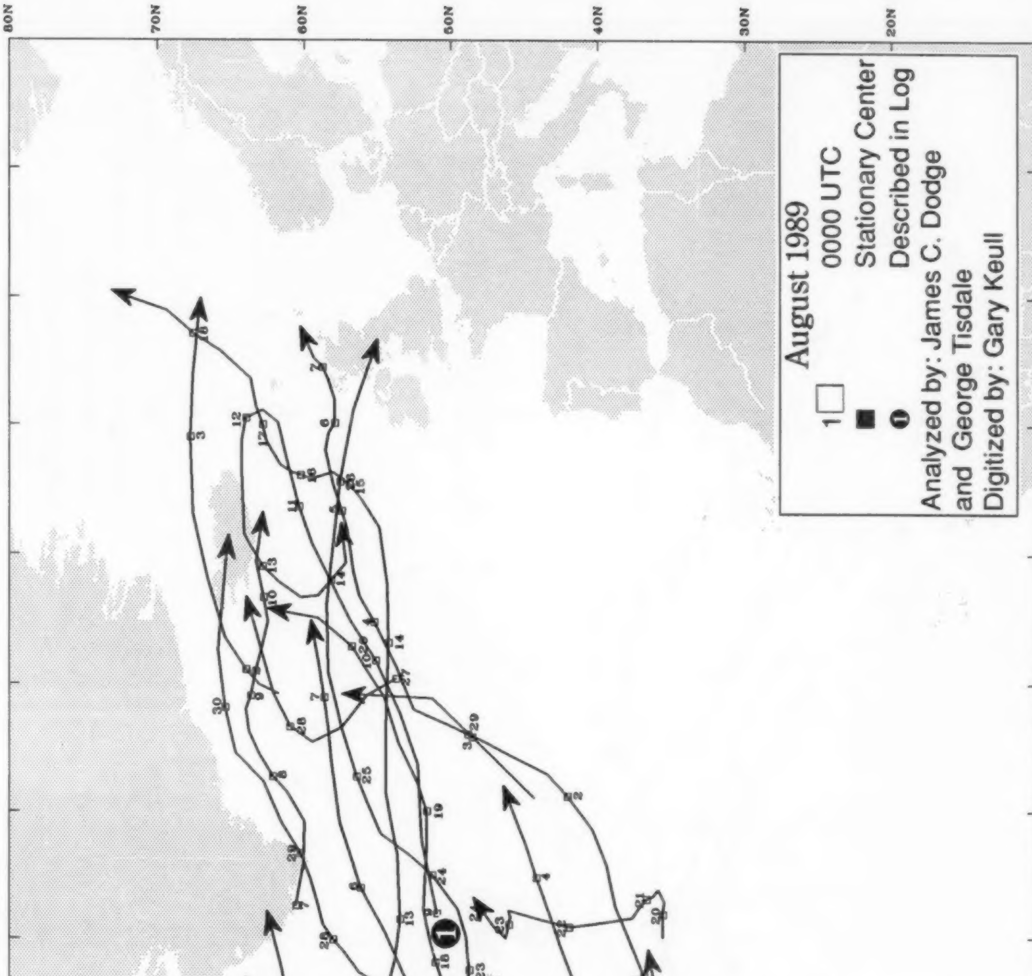
Six men, including five crewmen of a Panamanian bulk carrier, were missing after the ship was driven aground, on the 8th, during Typhoon Sarah. Heavy swell broke hawsers and the mooring chain on the ***Lung Hao*** at Hualien Harbor, some 100 mi south of Taipei. The vessel ran aground in the outer harbor and broke in two parts at the No. 5 hold. Twenty–one crewmen were rescued, although it was reported that one policeman was missing during the rescue mission.

In addition, 16 people were feared to have died off the Philippines following the sinking of an oil tanker named ***Vishru.*** This was reported on the 9th and occurred about 140 mi west of the northern Philippine province of LaUnion. The ***Sartov*** is reported to have picked up 12 survivors, from the vessel, but a search of the area found no additional crewmen and it appeared the vessel had sunk. Typhoon Sarah was in the vicinity during this period although the report did not mention the storm directly.

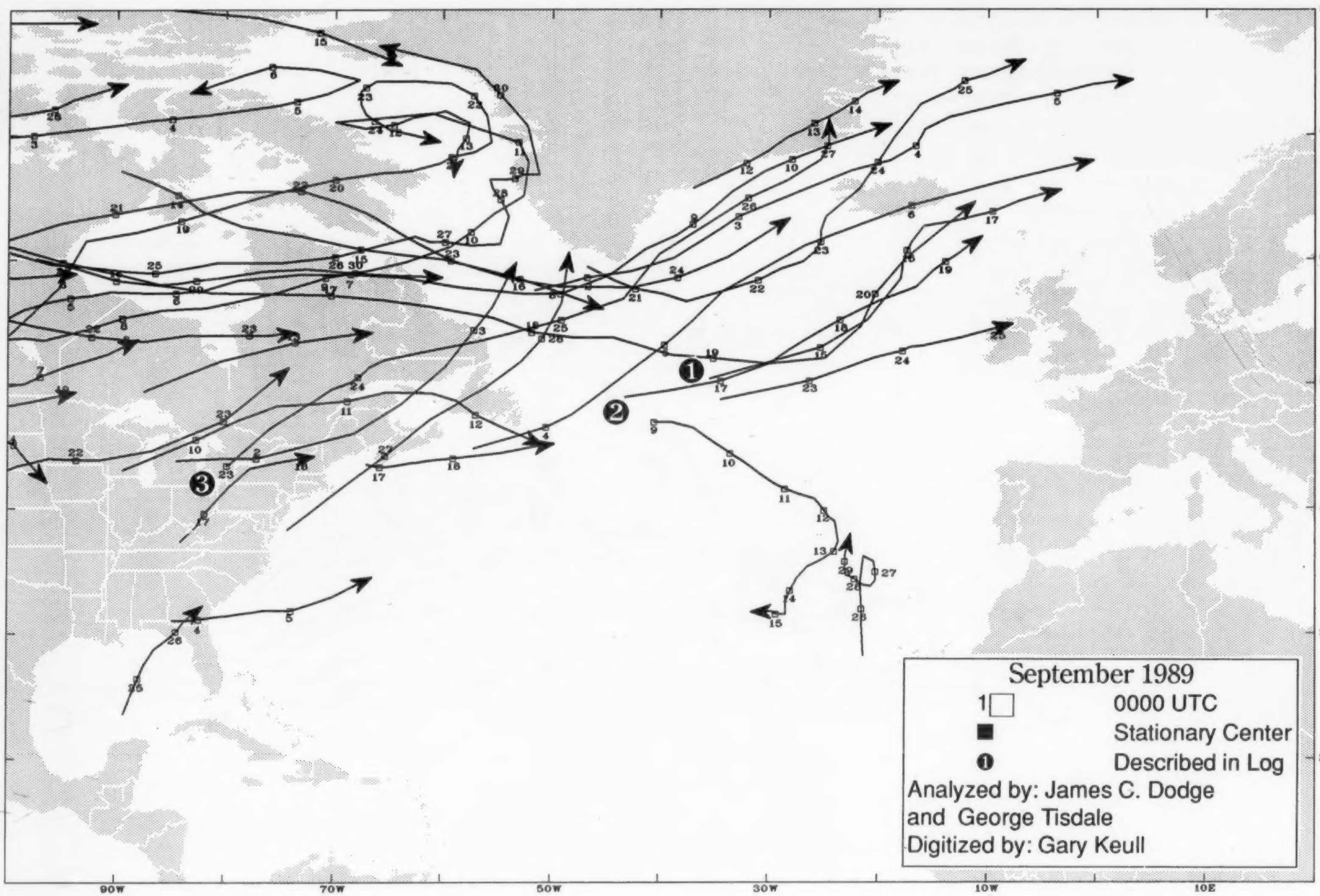
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



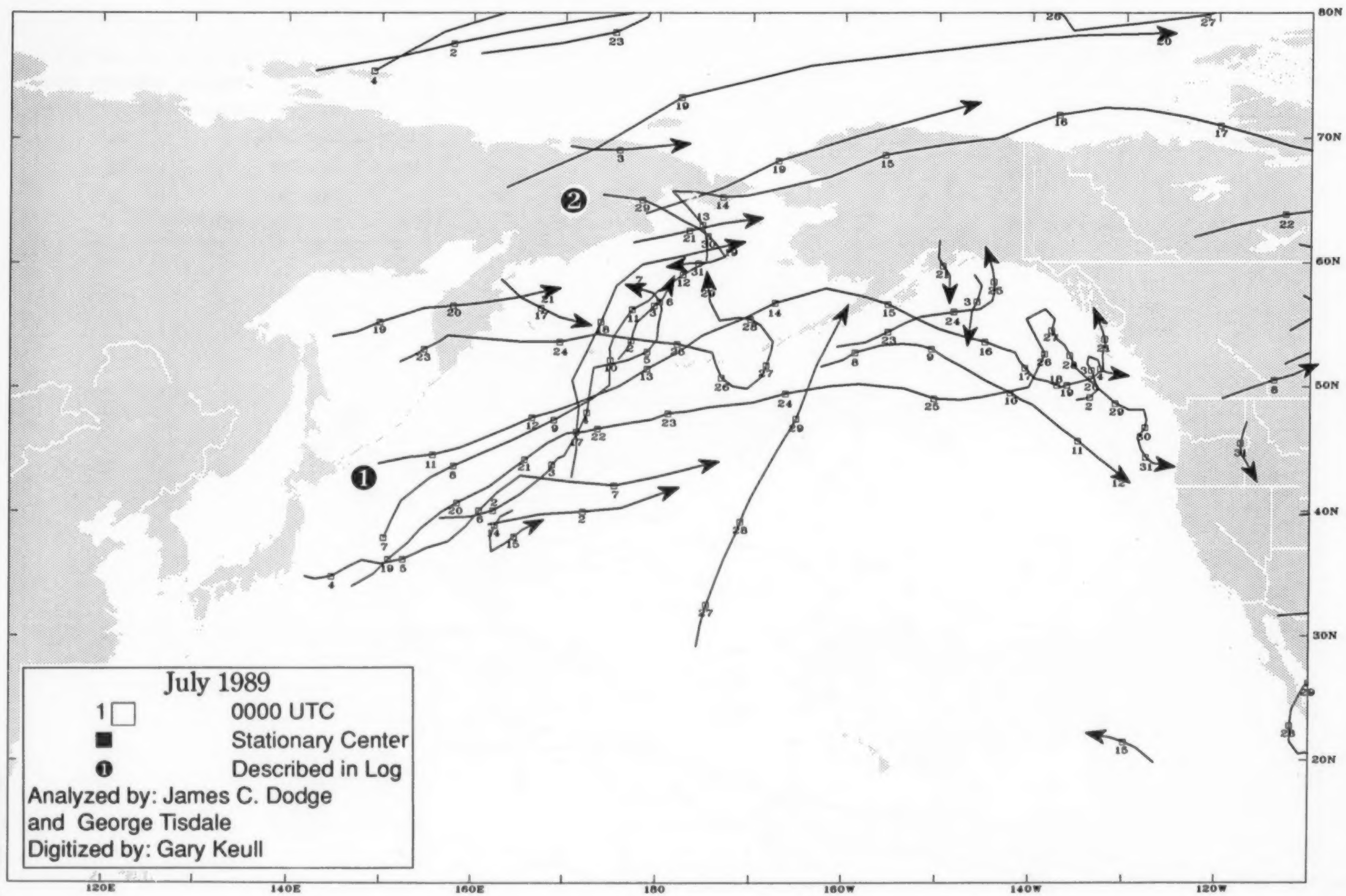
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



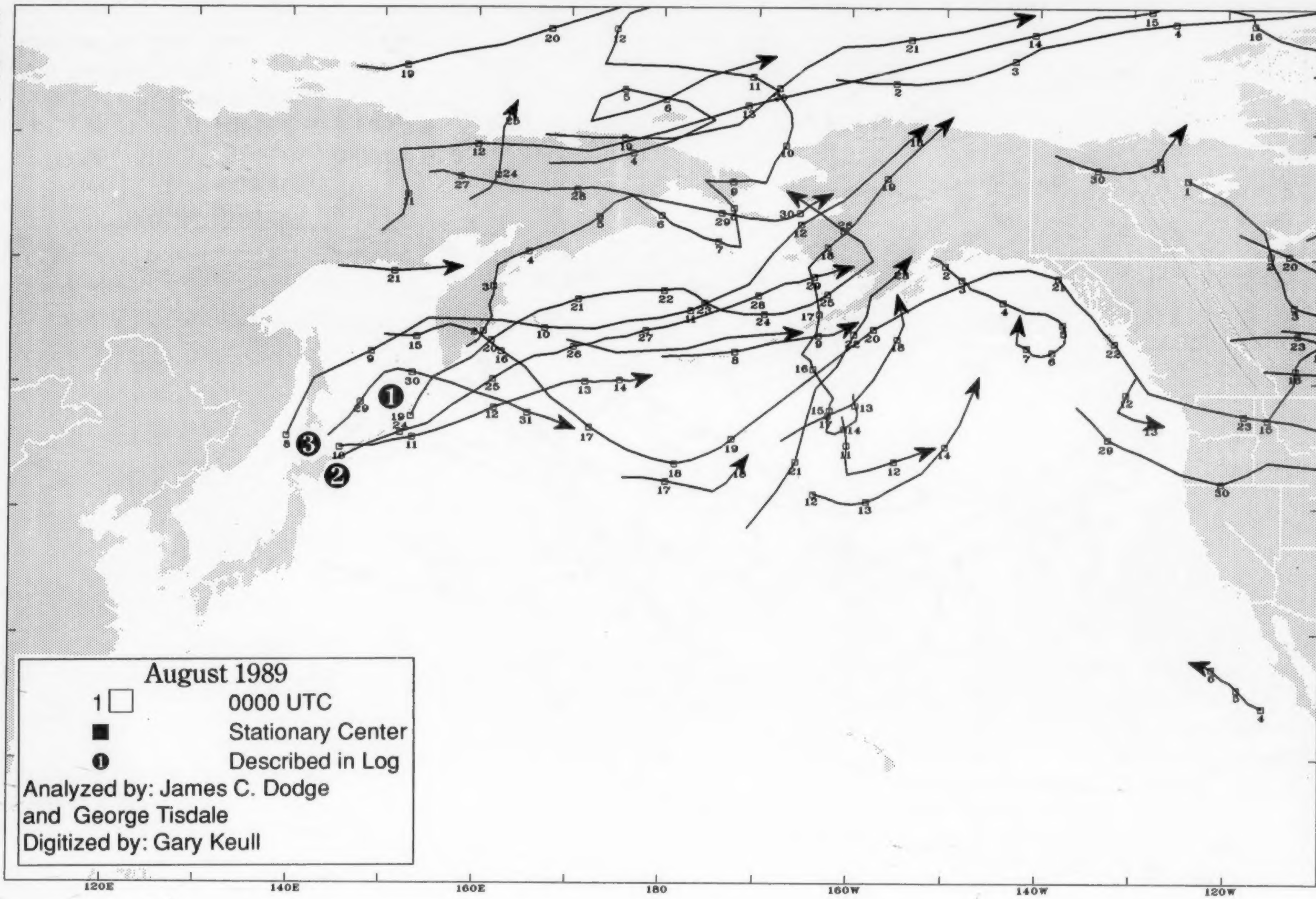
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



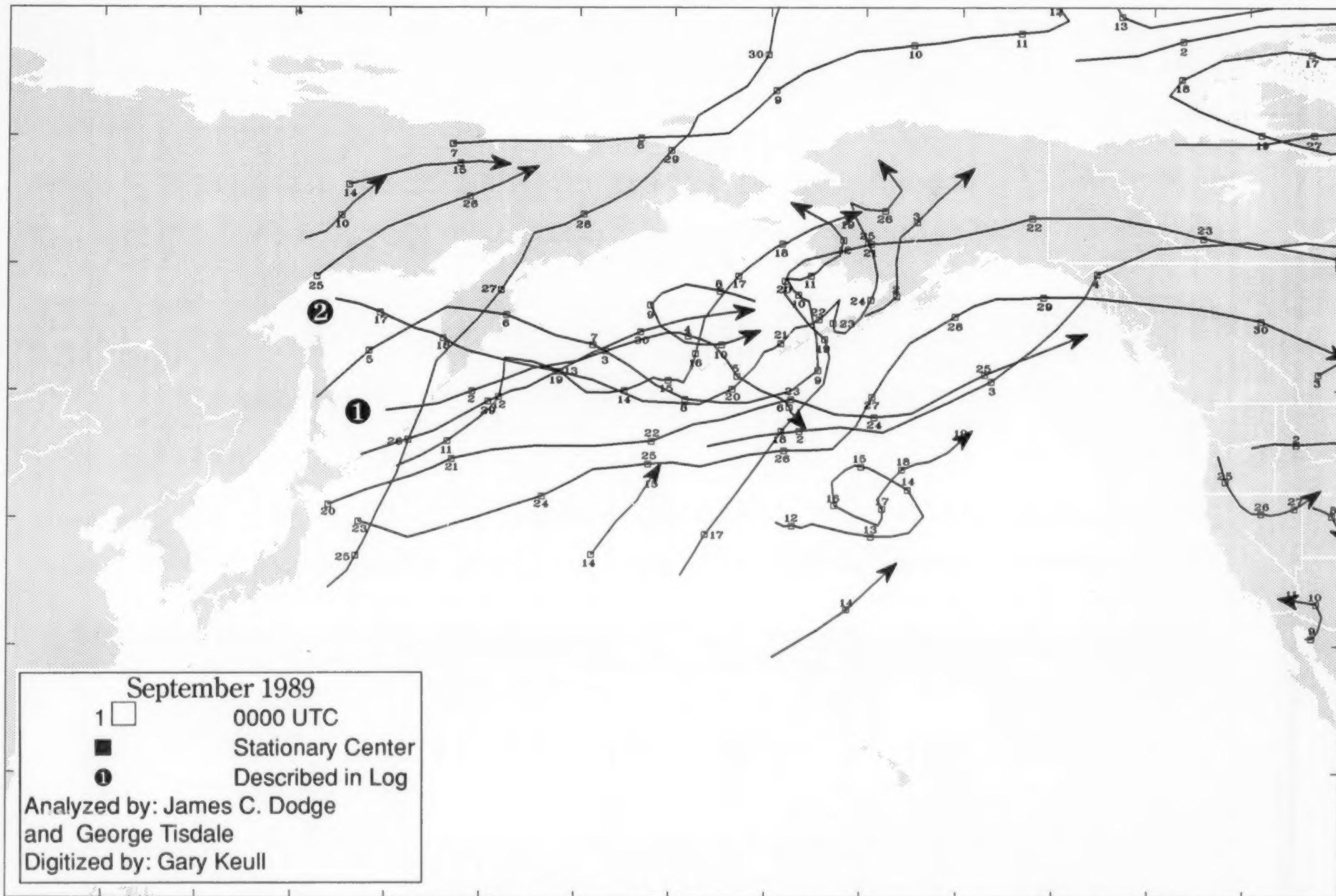
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



July, August and September 1989

VESSEL	SHIP CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.	VSBY	PRES WX. code	PRESS-URE mbs.	TEMP deg C. Air	TEMP deg C. Sea	SEA WAVES PD. sec	SEA WAVES HGT. ft.	SWELL WAVES DIR	SWELL WAVES PD. sec	SWELL WAVES HGT. ft.
PACIFIC JULY																		
SKAUBORD	LADC2	27	32.9 N	134.5 E	06	09	M	40	1 NM	63	1004.0	29.0	29.5	7	24.5	09	8	26
LING LEO	WDZB	27	31.3 N	131.6 E	06	03	M	46	2 NM	81	0991.5	27.0	26.7	4	10	07	12	36
SKAUBORD	LADC2	27	33.0 N	135.9 E	12	09	M	41	1 NM	63	1010.0	27.0	28.0	7	24.5	09	8	28
PRESIDENT HARRISON	WEZH	31	29.4 N	129.8 E	12	01		48	2 NM	07		25.5	25.5	5	14.5	01	7	19.5
ATLANTIC JULY																		
CHERRY VALLEY	WIBK	4	49.2 N	35.4 W	18	21		45	5 NM		1012.0	16.1	12.2	5	19.5	23	9	29.5
CHERRY VALLEY	WIBK	5	48.8 N	35.5 W	00	26		40	5 NM	03	1018.0	24.4	13.3	6	16.5	23	10	29.5
PACIFIC AUG.																		
LING LEO	WDZB	27	32.8 N	134.6 E	00	20	M	69	200 YD	65		24.0	27.7	13	49	22	13	49
PRESIDENT HARRISON	WEZH	27	32.1 N	133.0 E	00	27	M	40	2 NM	78	0987.0	23.3	26.6	6	19.5	27	7	32.5
LING LEO	WDZB	27	33.1 N	135.4 E	03	20	M	56	.25 NM	64		25.0	26.7	13	41	21	13	41
LING LEO	WDZB	27	33.3 N	136.2 E	06	19	M	58	2 NM	14		27.0	26.7	10	37.5	21	10	39
ATLANTIC AUG.																		
NEDLLOYD HOLLAND	KRHX	26	43.8 N	37.0 W	03	10	M	50	2 NM	82	0998.5	24.4		7	18	09	11	23
PACIFIC SEP.																		
GREAT LAND	WFDP	4	54.4 N	135.1 W	00	23	M	45	5 NM	82	1008.9	15.6	16.7	7	6.5	23	10	24.5
PRESIDENT KENNEDY	WRYE	6	45.3 N	156.4 W	00	16	M	40	5 NM		1015.0	20.5	17.6	6	13	16	10	19.5
NOBLE STAR	KRPP	6	38.8 N	160.1 W	06	16		44	5 NM		1007.1	22.9	23.0	3	10	18	7	19.5
SEALAND HAWAII	KIRF	10	19.2 N	128.5 E	06	18		45	5 NM	02	0997.8	31.1	29.4	5	8	18	12	21
SEALAND HAWAII	KIRF	10	19.1 N	128.1 E	12	18		45	5 NM		0999.0	28.9	29.4	5	10	18	12	21
SEALAND HAWAII	KIRF	10	19.0 N	127.7 E	18	18		45	5 NM		0998.5	26.7	29.4	5	10	18	12	21
SEALAND HAWAII	KIRF	10	18.8 N	127.6 E	21	19		45	5 NM		0998.8	28.9	28.9	6	13	21	13	21
SEALAND HAWAII	KIRF	11	18.7 N	127.4 E	00	19		45	5 NM		0999.8	27.8	28.9	6	13	21	13	21
SEALAND HAWAII	KIRF	11	18.6 N	126.9 E	06	20		45	5 NM		0998.6	31.1	28.3	6	13	19	13	23
SEALAND HAWAII	KIRF	11	18.5 N	126.4 E	12	20		42	5 NM		0999.0	28.9	28.3	6	13	19	13	21
PRESIDENT WASHINGTON	WHRN	12	22.5 N	122.5 E	06	23		45	5 NM	16		27.8	27.8	6	16.5	23	9	23
GUANAJUATO	HPRR	13	37.4 N	160.1 E	06	32		48	2 NM	51	0995.0	26.0	25.0	5	18	30	9	19.5
BRIGIT MAERSK	9VOY	19	46.8 N	177.8 W	12	19		70	2 NM	07	0984.5	12.0		7	18	XX	XX	24.5
BRIGIT MAERSK	9VOY	19	46.5 N	178.2 W	15	17		70	2 NM	07	0979.0	12.0		XX	24.5	19	11	32.5
BRIGIT MAERSK	9VOY	19	46.0 N	178.8 W	18	24	M	70	50 YD	07	0996.8	10.0		17	26	25	20	29.5
BRIGIT MAERSK	9VOY	19	45.7 N	179.4 W	21	26	M	62	200 YD	07	0983.1	11.0		13	28	27	16	29.5
BRIGIT MAERSK	9VOY	20	45.6 N	179.8 W	00	28	M	55	1 NM		0988.6	12.0		10	21	28	14	26
BRIGIT MAERSK	9VOY	20	45.2 N	179.4 E	03	29	M	50	2 NM	07	0993.0	11.0		9	16.5	28	12	29.5
MCKINNEY MAERSK	OWEQ2	20	48.3 N	168.0 W	03	17	M	65	1 NM	21	0984.0	14.0		16	32.5			
MCKINNEY MAERSK	OWEQ2	20	48.3 N	169.5 W	06	20	M	48	5 NM	80	0977.5	12.0		XX	19.5			
BRIGIT MAERSK	9VOY	21	41.3 N	165.3 E	15	27	M	60	2 NM	07	1000.5	17.0		12	16.5	27	14	24.5
BRIGIT MAERSK	9VOY	21	41.0 N	164.3 E	18	28	M	60	1 NM	07	1003.2	16.0		10	19.5	27	14	32.5
SKAUBORD	LADC2	21	39.9 N	162.6 E	18	29	M	41	5 NM	03	1009.5	17.5	22.5	7	19.5	29	7	21
BRIGIT MAERSK	9VOY	22	40.7 N	163.1 E	00	31		40	1 NM	16	1012.0	15.0		9	16.5	30	16	26
USNS SEALIFT MED	NMHT	30	53.7 N	172.0 W	18	26		40	5 NM	01	0998.5	6.7	6.7	8	19.5	26	10	24.5
ATLANTIC SEP.																		
CHEVRON NAGASAKI	A8BK	1	13.9 N	35.0 W	12	05	M	45	5 NM	82		26.0	22.8			09	10	19.5
CHEVRON NAGASAKI	A8BK	1	14.0 N	34.6 W	18	14	M	41	5 NM		1004.3	27.0	27.8			14	10	23
GALVESTON BAY	WPVF	9	47.6 N	35.1 W	06	11		45	1 NM	64	1004.0	18.6	18.3	8	19.5	11	8	19.5
RAINBOW BRIDGE	JAON	9	44.1 N	36.6 W	18	30	M	44	2 NM		1006.0	22.0	20.0	8	23	33	10	23
NEDLLOYD HUDSON	WPWH	18	49.3 N	13.2 W	06	22		42	2 NM		0994.3	18.0	17.2	4	10	22	8	21
SEALAND EXPEDITION	WPGJ	19	20.4 N	65.7 W	06	14		40			1002.0	27.2	27.8	6	14.5	14	6	21
AMERICAN MAINE	WPKB	22	33.6 N	76.7 W	00	09		45	2 NM	62	1007.5	28.3	22.2	5	16.5	11	10	24.5
AMERICAN MAINE	WPKB	22	34.1 N	75.6 W	06	12		43	5 NM	01	1012.0	28.3	22.8	7	19.5			
EVER GLEEFUL	BKJY	27	43.3 N	53.7 W	12	18	M	43			1008.0	24.0		10	24.5	18	12	26
CHABLIS	WEMS	30	45.4 N	20.5 W	18	07		40	5 NM		1025.9	17.8	16.7	4	10	08	7	21

July, August and September 1989

Ship Name	radio	mail
1ST LT ALEX BONNYMAN	7	
2ND LT. JOHN P. BOBO	70	66
A. V. KASTNER	120	
ABBEY	172	
ACADIA FOREST	47	124
ACE	15	19
ACE ACCORD	47	62
ACE ENTERPRISE	24	127
ACONCAGUA	13	
ACT 11	49	
ACT 111	156	
ACT 12	94	
ACT 5	121	
ACT 6	156	
ACT 7	111	
ACT 9	66	
ACT I	44	
ACT IV	67	
ADABELLE LYKES	65	
ADDIRIYAH	41	37
ADMIRALTY BAY	44	145
AFRICAN FERN	46	44
AGNES	17	50
AL AHMADIAH	2	
ALAIN LD	62	
ALASKA RAINBOW	28	96
ALBERT MAERSK	6	20
ALDEN W. CLAUSEN	68	128
ALEMANIA EXPRESS	53	
ALLIGATOR FORTUNE	36	53
ALLIGATOR GLORY	33	5
ALLIGATOR HOPE	59	132
ALLIGATOR LIBERTY	76	
ALLIGATOR TRIUMPH	62	111
ALMERIA LYKES	42	18
ALPHA HELIX		140
ALTAMONTE	26	39
ALVA MAERSK	9	
AMBASSADOR	25	62
AMBASSADOR BRIDGE	82	50
AMERICA EXPRESS	50	
AMERICA SUN	34	97
AMERICAN ALABAMA	58	113
AMERICAN CONDOR	15	28
AMERICAN CORMORANT	25	17
AMERICAN EAGLE	47	41
AMERICAN FALCON	30	20
AMERICAN MAINE	71	58
AMERICAN REPUBLIC	75	156
AMERICAN RESOLUTE	41	62
AMERICAN UTAH	68	50
AMERICAN VIRGINIA	67	53
AMERICANA	45	88
ANDERS MAERSK	55	158
ANTHONY RAINBOW	20	
AQUA CITY	54	104
AQUA GARDEN	51	56
AQUARIUS	51	164
ARCO ALASKA	17	25
ARCO ANCHORAGE	24	11
ARCO CALIFORNIA	30	35
ARCO FAIRBANKS	25	45
ARCO INDEPENDENCE	15	21
ARCO JUNEAU	26	43
ARCO PRUDHOE BAY	34	47
ARCO SAG RIVER	14	15
ARCO SPIRIT	16	29
ARCO TEXAS	19	37
ARCTIC DISCOVERER	145	83
ARCTIC TOKYO	28	185
ARGONAUT	45	43
ARGUS EXPLORER	10	
ARILD MAERSK	36	165
ARION	44	4
ARMCO	145	223
ARNOLD MAERSK	66	44
ARTHUR M. ANDERSON	210	237
ASHLEY LYKES	21	22
ASPEN	23	36
ASTERIKS	36	
ASTORIA	104	
ASTRO JYOJIN	3	91
ATIGUN PASS	4	124
ATLA	24	35
ATLANTIC	86	
ATLANTIC CARTIER	97	
ATLANTIC COMPANION	66	
ATLANTIC CONVEYOR	77	
ATLANTIC SPIRIT	9	17
ATLANTIS II	6	9
AURORA	24	
AURORA ACE	92	
AUSTRAL RAINBOW	1	13
B.T. SAN DIEGO	71	159
BAAB ULLAH	74	170
BACTAZAR	19	53
BADGER	31	248
BARRYDALE	90	
BATTERSEA	30	22
BAY BRIDGE	119	60
BEACON	1	
BEBEOURO	67	
BEER SHEVA	27	
BELGIAN SENATOR	80	
BELLE RIVER	114	261
BELLFLOWER	10	
BHARATENDU	3	
BIBI	107	
BLACKHAWK		150
BLUE HAWK	71	
BOGASARI LIMA	77	67
BOHOL SAMPAGUITA	42	87
BRIGIT MAERSK	21	140
BRILLIANT ACE	64	
BROOKLYN	32	52
BROOKLYN BRIDGE	84	
BROOKS RANGE	29	24
BUNGA KENANGA	8	
BUNGA KESIDANG	12	
BUNGA MELAWIS	34	
BUNGA TEMBUSU		60
BURNS HARBOR	156	241
CAGUAS	4	
CALCITE II	106	118
CALIFORNIA HERMES	41	42
CALIFORNIA ZEUS	55	
CANADIAN RAINBOW	32	55
CANAL ACE	2	
CAPE BYRON	68	
CAPE HENRY	59	
CAPE HORN	13	
CAPE YORK	185	
CAPRICORN	13	35
CARIBE 1	7	37
CARLA A. HILLS	7	137
CAROL	12	23
CAROLINA	63	142
CASON J. CALLAWAY	97	125
CATTLEYA ACE		136
CELEBRATION	83	106
CGM LORRAINE	14	
CHABLIS	121	228
CHACO	19	
CHARLES M. BEEGHLEY	6	
CHARLOTTE LYKES	97	132
CHELSEA	18	42
CHEMBULK CLIPPER	8	
CHEMICAL PIONEER	60	30
CHERRY VALLEY	19	63
CHESAPEAKE BAY	47	151
CHESAPEAKE TRADER	34	21
CHESNUT HILL	25	22
CHEVRON ANTWERP	32	
CHEVRON ARIZONA	22	39
CHEVRON BURNABY	32	78
CHEVRON CALIFORNIA	149	213
CHEVRON EDINBURGH	42	64
CHEVRON EQUATOR	11	36
CHEVRON FELUY	4	124
CHEVRON LONDON		220
CHEVRON LOUISIANA	11	17
CHEVRON METEOR	90	175
CHEVRON MISSISSIPPI	31	111
CHEVRON NAGASAKI		233
CHEVRON OREGON		3
CHEVRON SKY	54	419
CHEVRON STAR		174
CHEVRON SUN	4	
CHEVRON WASHINGTON	22	63
CHICKASAW	12	
CHINA CONTAINER	23	33
CHRISTINA	140	
CITADEL HILL	23	
CLARENCE	45	
CLEMENT	61	
CLEVELAND	9	
CO-OP EXPRESS I	24	
CO-OP EXPRESS II	30	
COAST RANGE	13	24
COASTAL MANATEE	36	39
COLIMA	46	98
COLUMBIA STAR	55	97
COLUMBUS AMERICA	220	
COLUMBUS AUSTRALIA	39	
COLUMBUS CANADA	95	
COLUMBUS ISELIN	4	
COLUMBUS LOUISANA	94	
COLUMBUS NEW ZEALAND	170	
COLUMBUS OHIO	4	
COLUMBUS QUEENSLAND	128	
COLUMBUS VICTORIA	89	
COLUMBUS VIRGINIA	111	
COLUMBUS WELLINGTON	97	
CONCERT EXPRESS	88	
CONTI BAVARIA	38	47
CONTINENTAL HIGHWAY	29	
CORAH ANN	9	97
CORMORANT ARROW	46	
CORNUCOPIA	71	183
CORONADO	18	
CORWITH CRAMER	27	
COURIER	19	
COURTNEY BURTON	54	104
CPL. LOUIS J. HAUGE JR	39	62
D.L. BOWER		154
DAVID PACKARD	1	
DELAWARE BAY	45	99
DELAWARE TRADER	44	96
DIANA	5	29
DIRECT EAGLE	112	324
DON JORGE	1	79
DUBHE	8	
DUSSELDORF EXPRESS	77	
E.H.GOTT		34
EASTERN FRIENDSHIP	24	70
EASTERN GLORY	79	46
EASTERN VENTURE	43	41
EDGAR B. SPEER	148	193
EDGAR M. QUEENY	26	77
EDWARD L. RYERSON	46	85
EDWIN H. GOTT	167	179
ELIZABETH LYKES	42	35
ELTON HOYT II		8
EMERALD SEA	152	103
EMPIRE STATE	15	
ENDEAVOR	57	78
ENSOR	75	130
ERLANGEN EXPRESS	41	
ESSO PALM BEACH	1	
ESSO PUERTO RICO	5	14
EVER GAINING	20	
EVER GARDEN		2
EVER GATHER	7	
EVER GENTLE	3	
EVER GIANT	1	38
EVER GIFTED	8	
EVER GIVEN	18	
EVER GLAMOUR	10	16
EVER GLEEFUL	3	55
EVER GLOBE	4	5
EVER GLORY	9	
EVER GLOWING	3	5
EVER GOLDEN	6	
EVER GOVERN		5
EVER GRACE	9	
EVER GRADE	5	18
EVER GRAND	5	9
EVER GROUP	5	5
EVER GROWTH	6	10
EVER GUARD	21	2
EVER GUIDE	23	
EVER LAUREL	8	
EVER LIVING	1	
EVER LYRIC	1	
EXPORT FREEDOM	40	23
EXPORT PATRIOT	11	96
EXXON BATON ROUGE	15	42
EXXON BENICIA	7	8
EXXON CHARLESTON	9	
EXXON LONG BEACH	2	2
EXXON NEW ORLEANS	15	17
EXXON NORTH SLOPE	10	14
EXXON PHILADELPHIA	5	
EXXON PRINCETON	19	25
EXXON SAN FRANCISCO	3	7
EXXON YORKTOWN	15	15
FALCON LEADER	5	
FALSTAFF	6	
FALSTRIA	35	92
FARLAND	1	
FARNELLA	40	
FAUST	85	64
FERNCROFT	139	179
FESTIVALE	99	114
FETISH	78	185
FIGARO		23
FINNROSE	38	84
FLORIDA RAINBOW	82	151
FOREST SOVEREIGN	85	283
FORTALEZA	75	135
FRANCES HAMMER		11
FRANCIS SINCERE NO. 6	61	61
FRED R. WHITE	18	61
FREDERICKSBURG	31	40
FREEDOM		45
GALVESTON BAY	59	182
GATEWAY EAST	68	112
GEMINI	82	164
GENERAL M.BELGRANDO	1	
GENEVIEVE LYKES	15	65
GEORGE A. SLOAN	213	242
GEORGE A. STINSON	65	188
GEORGE H. WEYERHAEUSER	13	47
GEORGE WASHINGTON BRID	192	
GEORGIA		48
GERMAN SENATOR	53	
GERONIMO	24	29
GLACIER BAY	65	88
GLOBAL WING	83	
GLORIA	17	
GLORIOUS SPICA	68	
GLORY STAR	25	51
GOLDEN APO	43	20
GOLDEN ENDEAVOR	18	43
GOLDEN GATE	1	5
GOLDEN GATE BRIDGE	182	
GOLDEN HAWK	54	45
GRAIGLAS	152	
GREAT LAND	250	330
GREEN ANGELES	8	12
GREEN BAY	108	221
GREEN ELLIOTT		50
GREEN HARBOUR	37	9
GREEN HAWK	5	
GREEN ISLAND	29	
GREEN KOBE	2	29
GREEN LAKE	55	49
GREEN MASTER	1	64
GREEN MAYA	55	68
GREEN RAINIER	23	71
GREEN RIDGE	132	106
GREEN SAIKAI	2	
GREEN SASEBO	37	172
GREEN STAR	25	38
GREEN VALLEY	27	22
GREEN WAVE	32	18
GUANAJUATO	92	196
GUAYAMA	79	149
GULF IDEAL	50	
GULF KING	1	
GYPSUM BARON	119	36
GYPSUM KING	291	
HAKONE MARU	113	
HANEI SKY	34	100
HANEI SUN	6	
HANJIN BUSAN	50	19
HANJIN CHEJU	1	
HANJIN CHUNGMU	37	31
HANJIN GHEJU		32
HANJIN HONG KONG	26	
HANJIN KEELUNG	34	12
HANJIN KOBE	29	14
HANJIN KUNSAN	35	46
HANJIN KWANGYANG	33	
HANJIN LONG BEACH	23	
HANJIN MOKPO	6	9
HANJIN NEW YORK	25	16
HANJIN POHANG		32
HANJIN SAVANNAH	24	
HANJIN SEATTLE	20	
HANJIN SEOUL	42	
HANJIN YOKOHAMA	14	16
HANJIN YOSU	42	25
HANSA CARRIER	61	
HARMAC DAWN	92	
HASSAN MERCHANT	59	57
HAWAIIAN RAINBOW	31	
HEIDE	322	
HENRY HUDSON BRIDGE	205	
HENRY STEINBRENNER	65	107
HERBERT C. JACKSON	3	
HERMENIA	58	65
HIRA #2	74	
HOEGH CAIRN	1	6
HOEGH CLIPPER	12	20
HOEGH DENE	5	20

Ship Name	radio	mail
HOEGH DRAKE	14	
HOEGH DYKE	22	47
HOEGH MIRANDA	6	13
HOHSING ARROW	1	
HOHSING BREEZE	20	
HOLIDAY	55	61
HOLSTEN CARRIER	67	47
HOLSTEN TRADER	1	
HONESIA	9	17
HONOLULU	106	
HOWELL LYKES	51	78
HRELJIN	59	
HUAL ANGELITA	15	17
HUAL TRANSPORTER	22	70
HUMACAO	88	205
HUMBER ARM	7	
HYUNDAI #108	6	
HYUNDAI CHALLENGER	39	
HYUNDAI COMMANDER	78	40
HYUNDAI CONTINENTAL	68	84
HYUNDAI EXPLORER	20	17
HYUNDAI INNOVATOR	31	31
HYUNDAI ISLAND	44	
HYUNDAI NO. 107	2	
HYUNDAI PIONEER	25	19
IBIS ARROW	19	
IMPERIAL	9	
INCOTRANS PACIFIC	128	
INFANTA	103	
INGER	100	189
IRMA M	132	
IRVING L. CLYMER	68	68
ISLAND PRINCESS	124	
ITAITE	34	
ITAPE	64	
ITB PHILADELPHIA	150	62
IZOLA	1	
J. BURTON AYERS	72	63
J.L. MAUTHE	24	
JADRAN EXPRESS	2	
JALISCO	66	145
JAMES LYKES	4	8
JAPAN ALLIANCE	85	62
JAPAN APOLLO	82	51
JEAN LYKES	16	
JO BIRK	121	
JO CLIPPER	145	
JO CYPRESS	77	
JO GRAN	29	72
JO LONN	92	
JO OAK	158	
JOHN G. MUNSON	199	232
JOHN LYKES	30	58
JOSEPH H. FRANTZ	12	65
JOSEPH L. BLOCK	3	14
JOSEPH LYKES	49	29
JOVIAN LILY	72	179
JSS MEONIA	92	95
JUBILEE	80	95
JULIUS HAMMER	50	86
KALIDAS	93	
KAUAI	43	160
KAYE E. BARKER	31	42
KEISHO MARU	70	35
KENAI	46	46
KENNETH T. DERR	55	76
KENT	28	103
KENTUCKY HIGHWAY	21	
KEYSTONE CANYON	20	29
KEYSTONER	48	166
KIILSA		48
KISO	121	
KITTANNING	1	
KOKUA	44	82
KOLN EXPRESS	156	
KONAI		22
KOPER EXPRESS	38	
KOTA PETANI	43	24
KUROBE	68	
L.T. ARGOSY	30	61
LA PAMPA	20	
LAGO PETEN ITZA	1	34
LANCASHIRE	1	
LARS MAERSK	58	88
LASH ATLANTICO	20	
LAURA MAERSK	21	67
LAWRENCE H. GIANELLA	58	57
LEDA MAERSK	24	87
LEISE MAERSK	35	93
LERMA	136	
LEROS COURAGE	15	48
LESLIE LYKES	23	87
LETITIA LYKES	41	45
LEWIS WILSON FOY	186	409
LEXA MAERSK	55	79
LIBERTADOR GRAL SAN MA	4	
LIBERTY SUN	67	182
LIBERTY WAVE	32	29
LICA MAERSK	88	164
LILAS		222
LILLY STAR	12	
LING LEO	54	191
LIONS GATE BRIDGE	35	135
LIRCAY	63	
LLOTD ITAJAI	116	
LLOYD SAO PAULO	97	
LLOYD VITORIA	91	
LNG LOUISIANA	37	
LNG TAURUS	29	174
LONG LINES	84	
LOTUS ACE	52	
LOUIS MAERSK	26	51
LOUISIANA BRIMSTONE	36	88
LT. ODYSSEY	16	18
LURLINE	54	161
LUZON	33	54
LUZON SAMPAGUITA	40	40
LYRA	51	51
M. P. GRACE	26	
M/V MARINE RELIANCE	34	10
MACKINAC BRIDGE	193	64
MADAME BUTTERFLY	40	
MAERSK CONSTELLATION	88	200
MAERSK SUN	31	
MAERSK TACOMA	30	
MAERSK WIND	114	219
MAGALLANES	17	22
MAGIC	63	141
MAJ STEPHEN W PLESS MP	16	30
MALLORY LYKES	90	45
MANHATTAN BRIDGE	178	

Ship Name	radio	mail
MANILA PROSPERITY	1	
MANUKAI	56	187
MANULANI	59	171
MARATHA MAJESTY	6	
MARATHA PROVIDENCE	1	
MARCHEN MAERSK	19	63
MARGARET LYKES	55	92
MARGRETHE MAERSK	25	75
MARIA TOPIC	44	197
MARIF	38	21
MARIT MAERSK	57	69
MARITIME ASSOCIATE	35	
MARJORIE LYKES	42	128
MARLIN		176
MARY ANNE	36	
MASON LYKES	49	78
MATSONIA	41	127
MAUI	78	206
MAWASH TAPUK	12	
MAYAGUEZ	76	39
MCKINNEY MAERSK	23	32
MEDALLION	120	144
MEDUSA CHALLENGER	24	52
MELANIE		154
MELBOURNE HIGHWAY	28	27
MELGAR BAY	9	
MELVILLE	69	68
MERCANDIAN CONTINENT	36	15
MERCANDIAN SUN II	42	110
MERCURY ACE	47	
MERIDA	95	148
MESABI MINER	198	298
METTE MAERSK	54	115
MICHIGAN	2	14
MICHIGAN HIGHWAY	8	
MICRONESIAN COMMERCE	49	24
MICRONESIAN INDEPENDEN	8	56
MINDORO SAMPAGUITA	20	76
MINERAL HOBOKEN	1	
MINERVA	4	
MING ENERGY	19	19
MING GLORY	5	22
MING MOON	14	20
MING OCEAN	13	7
MING PROMOTION	27	17
MITLA	54	38
MOANA PACIFIC	25	77
MOANA WAVE		30
MOBIL ARCTIC	19	42
MOBIL MERIDIAN	1	127
MOKU PAHU	19	21
MORELOS	55	63
MORMACSKY	51	98
MORMACSTAR	61	120
MORMACSUN	91	20
MOSEL EXPRESS	124	
MOSMAN STAR	20	
MSC CHIARA	66	47
MSC SABRINA	30	
MYRON C. TAYLOR	126	113
NACIONAL SANTOS	8	
NADA 2	83	233
NANCY LYKES	16	14
NARA	87	160
NATIONAL DIGNITY	33	58
NATIONAL HONOR	29	107
NATIONAL PRIDE	13	76
NAVIGATOR		94
NAVIOS ENTERPRISE	11	
NAVIOS UNIQUE	194	
NECHES	2	6
NEDLLOYD ALKMAAR	98	
NEDLLOYD BAHRAIN	104	
NEDLLOYD BALTIMORE	109	
NEDLLOYD BANGKOK	99	
NEDLLOYD BARCELONA	87	
NEDLLOYD ELBE	60	
NEDLLOYD HOLLAND	51	166
NEDLLOYD HUDSON	59	128
NEDLLOYD KEMBLA	30	
NEDLLOYD KINGSTON	145	
NEDLLOYD KYOTO	157	
NEDLLOYD ROCHESTER	80	
NEDLLOYD ROTTERDAM	70	
NEDLLOYD ROUEN	99	
NEDLLOYD VAN CLOON	79	172
NEPTUNE ACE	72	
NEPTUNE AMBER	95	266
NEPTUNE CORAL	56	128
NEPTUNE CRYSTAL	52	
NEPTUNE DIAMOND	66	
NEPTUNE GARNET	35	
NEPTUNE IVORY	19	
NEPTUNE JADE	64	
NEPTUNE PEARL	104	208
NEPTUNE TOURMALINE	1	
NEW HORIZON	125	192
NEW LAPIS	1	
NEW NOBLE	10	40
NEW RUBY	22	39
NISSAN LAUREL	45	
NOAA DAVID STARR JORDA	171	188
NOAA SHIP CHAPMAN	357	244
NOAA SHIP DELAWARE II	198	261
NOAA SHIP DISCOVERER O	460	
NOAA SHIP FAIRWEATHER	27	23
NOAA SHIP FERREL	102	85
NOAA SHIP HECK 591	23	30
NOAA SHIP JOHN N COBB	76	74
NOAA SHIP M. BALDRIDGE	420	469
NOAA SHIP MCARTHUR	372	192
NOAA SHIP MILLER FREEM	280	136
NOAA SHIP MT MITCHEL	450	501
NOAA SHIP OREGON II	390	306
NOAA SHIP RAINIER	181	183
NOAA SHIP RUDE 590	29	59
NOAA SHIP SURVEYOR	51	
NOAA SHIP T. CROMWELL	218	244
NOAA SHIP WHITING	309	440
NOBLE STAR	137	173
NORTH STAR	3	5
NOSAC EXPRESS	88	132
NOSAC RANGER	51	82
NOSAC TAKARA	2	
NOSAC TASCO	25	
NOSAC TRIGGER	87	38
NUEVO SAN JUAN	72	205
NURNBERG EXPRESS	97	
OAXACA	91	
OCEAN ASPIRATION	73	108
OCEAN AUSTRALIA	99	

Ship Name	radio	mail
OCEAN BRIDGE	25	
OCEAN CHEER	7	
OCEAN COMMANDER #1	3	
OCEAN LUCKY	31	119
OCEAN SEL	66	161
OCEAN SPIRIT	18	
OCEAN STEELHEAD	25	96
OGDEN WABASH	98	145
OLEANDER	106	59
OLGA TOPIC	28	103
OLIVE ACE	35	7
OMI CHAMPION	21	
OOCL EDUCATOR	46	49
OOCL FAIR	66	61
ORANGE BLOSSOM	59	51
ORANGE STAR	1	45
ORCHID	70	87
ORCHID #2	27	33
OREGON RAINBOW II	55	127
ORIENTAL DIPLOMAT	57	
ORIENTAL EDUCATOR	2	
ORIENTAL EXECUTIVE	99	71
ORIENTAL EXPLORER	73	22
ORIENTAL FAITH	29	106
ORIENTAL FORTUNE	30	72
ORIENTAL FREEDOM	67	
ORIENTAL FRIENDSHIP	80	110
ORIENTAL KNIGHT	3	
ORIENTAL MINISTER	29	
ORIENTAL PATRIOT	1	
ORIENTAL PHOENIX		81
ORION HIGHWAY	50	
OVERSEAS BOSTON	25	117
OVERSEAS CHICAGO	1	
OVERSEAS JOYCE	85	155
OVERSEAS JUNEAU		19
OVERSEAS MARILYN	22	49
OVERSEAS NEW YORK	3	3
OVERSEAS VIVIAN	8	15
OVERSEAS WASHINGTON	14	30
PAC TRADER	20	18
PACBARON	10	
PACDUCHESS	154	
PACDUKE	20	
PACEMPEROR	13	11
PACGLORY	23	
PACIFIC ARROW	112	109
PACIFIC PRINCESS	73	
PACIFIC SENTRY	7	46
PACIFIC VENTURE	42	
PACIFIC VICTORY	18	12
PACKING	52	
PACMAJESTY	5	
PACMERCHANT	8	17
PACMONARCH	1	
PACNOBLE	43	
PACPRINCE	34	
PACPRINCESS	21	
PATRIOT	137	217
PAUL BUCK	143	137
PAUL H. TOWNSEND	18	
PAUL THAYER	4	
PECOS	16	34
PEGGY DOW	87	
PENNSYLANIA RAINBOW	29	91
PENNSYLVANIA TRADER	50	60
PERMEKE	22	
PERSEVERANCE	6	
PETER W. ANDERSON	39	65
PFC EUGENE A. OBREGON	45	55
PFC JAMES ANDERSON JR	19	
PFC WILLIAM B. BAUGH	6	18
PHAROS	147	
PHILIP R. CLARKE	132	155
PHILIPPINE VICTORY		91
PHOENIX DIAMOND	10	
PILAR	19	45
PINE FOREST	44	108
POLAR ALASKA	12	197
POLYNESIA	223	211
POMEROL	8	
POTOMAC TRADER	30	85
PRESIDENT ADAMS	76	183
PRESIDENT ARTHUR	12	44
PRESIDENT BUCHANAN	6	
PRESIDENT EISENHOWER	157	210
PRESIDENT F. ROOSEVELT	85	136
PRESIDENT GRANT	65	114
PRESIDENT HARDING	13	80
PRESIDENT HARRISON	124	186
PRESIDENT HOOVER	92	85
PRESIDENT JACKSON	58	188
PRESIDENT KENNEDY	77	102
PRESIDENT LINCOLN	172	184
PRESIDENT MADISON	94	31
PRESIDENT MONROE	113	234
PRESIDENT POLK	57	193
PRESIDENT TRUMAN	102	192
PRESIDENT TYLER	65	169
PRESIDENT WASHINGTON	118	101
PRESQUE ISLE	197	332
PRINCE OF TOKYO	61	121
PRINCE OF TOYKO II	142	107
PRINCE WILLIAM SOUND	4	16
PRINCESS DIAN		48
PUERTO CORTES	75	46
PUNTA BRAVA	19	27
PURITAN	101	
PVT HARRY FISHER	21	
QUEEN ELIZABETH 2	116	
RAINBOW BRIDGE	73	59
RAINBOW HOPE	126	165
RALEIGH BAY	30	92
RANA M	48	
RANGER	66	
RANI PADMINI	1	
REGINA MAERSK	29	64
RESERVE	65	55
RHINE FOREST	72	129
RICHARD G MATTIESEN	91	33
RICHARD REISS	4	7
RIJEKA EXPRESS	47	
RIMBA KERUING	29	
RIO ESQUEL	78	75
RIO FRIO	123	
RIO GRANDE	2	
RIO LIMAY	36	
ROBERT E. LEE	20	
ROGER BLOUGH	2	
ROGER R. SIMONS	48	66
ROSETTA	15	

Ship Name	radio	mail
ROSINA TOPIC	17	
ROTTERDAM	17	
ROVER		58
ROYAL PRINCESS	64	
RUTH LYKES	19	79
S.T. CRAPO	102	200
SAM HOUSTON	20	
SAMAR VICTORY	1	
SAMOAN REEFER	18	
SAMRAT ASHOK	30	
SAMU	5	
SAN LUIS	46	74
SAN MARTIN I	84	
SAN MATEO VICTORY	5	19
SANKO HAWK	4	
SANKO MARQUESA	1	
SANKO PEACE	2	
SANKO PRELUDE	43	64
SANKO STORK	4	
SANSINENA II	38	49
SANTA ADELA	54	138
SANTA CRUZ II	110	
SANTA JUANA	122	
SANTA VICTORIA	23	38
SANWA MARU	13	
SATURN DIAMOND	32	168
SAUDI ABHA	4	
SAUDI DIRIYAH	88	
SAUDI HOFUF	10	
SAUDI TABUK	2	
SAVANNAH	89	
SAZAN	1	
SCARAB	93	120
SEA ACE	18	37
SEA BELLS	24	38
SEA COMMERCE	38	
SEA FAN	97	123
SEA FORTUNE	36	130
SEA FOX	21	93
SEA JADE	4	
SEA LANTERN	39	82
SEA LIGHT	33	156
SEA LION	248	255
SEA TRADE	116	
SEA WEALTH	6	
SEA WOLF	365	315
SEALAND ANCHORAGE	21	34
SEALAND ATLANTIC	64	71
SEALAND CHALLENGER	63	87
SEALAND COMMITMENT	54	82
SEALAND CONSUMER	16	54
SEALAND CRUSADER	113	140
SEALAND DEFENDER	53	210
SEALAND DEVELOPER	54	73
SEALAND DISCOVERY	73	150
SEALAND ENDURANCE	71	140
SEALAND ENTERPRISE	159	217
SEALAND EXPEDITION	46	180
SEALAND EXPLORER	34	135
SEALAND EXPRESS	55	29
SEALAND FREEDOM	46	
SEALAND HAWAII	107	236
SEALAND INDEPENDENCE	46	63
SEALAND INNOVATOR	47	103
SEALAND KODIAK	19	38
SEALAND LIBERATOR	56	118
SEALAND NAVIGATOR	133	214
SEALAND PACIFIC	82	233
SEALAND PATRIOT	75	119
SEALAND PERFORMANCE	66	149
SEALAND QUALITY	66	146
SEALAND TACOMA	36	44
SEALAND TRADER	123	233
SEALAND VOYAGER	135	184
SEAWARD BAY	38	
SEDCO/BP 471	70	115
SENATOR		90
SEVEN OCEAN	47	
SGT WILLIAM A BUTTON	3	
SGT. METEJ KOCAK	22	39
SHELDON LYKES	70	63
SHELLY BAY	31	44
SHENAHON	21	31
SHIN BEISHU MARU	43	
SHINKASHU MARU	147	
SHIRAOI MARU	40	40
SILVER CLIPPER	43	4
SINGAPORE VICTORY	10	46
SIOUX TATE	107	143
SKANDERBORG		70
SKAUBORD	82	140
SKAUGRAN	67	95
SKEENA	155	
SOLAR WING	58	148
SONBAI	115	41
SONORA	53	146
SOPHIA	38	
SOUTHLAND STAR	81	
SPRING BEAR	150	

Ship Name	radio	mail
SPRING BEE	33	53
SPRING SWIFT	25	34
SPRING VEGA	1	
SS ROVER	66	101
STAR DOVER	16	
STAR EAGLE	49	66
STAR EVVIVA	31	
STAR FLORIDA	74	
STAR FUJI	12	
STAR GEIRANGER	6	8
STAR GRAN	30	116
STAR HONG KONG	59	
STAR MINERVA	28	
STAR OF TEXAS	14	
STAR RANGER	33	
STELLA LYKES	20	62
STEWART J. CORT	158	200
STONEWALL JACKSON	21	29
STRATHCONON	177	
STRIDER ISIS	95	116
STRIDER JUNO	2	
STUTTGART EXPRESS	66	
SUE LYKES	20	
SUGAR ISLANDER	44	42
SUNBELT DIXIE	138	73
SUNNY SUPERIOR	9	82
SUNWARD II	92	
SWIFT TRADER	36	
SWIFTNES	27	72
TABASCO	64	124
TAI CHUNG	12	18
TAI LIENG	1	
TAI SHING	5	
TALISMAN	46	29
TAMPA	11	
TARGET	134	282
TAYABAS BAY	77	48
TEXACO NEW YORK	33	53
TEXACO VERAGUAS	113	204
TEXACO WESTCHESTER	71	11
THOMAS WASHINGTON	13	100
THOMPSON LYKES	14	
THOMPSON PASS	18	22
TNUISIAN REEFER	88	
TOBA	32	37
TOHZAN	6	2
TOKYO MARU	62	
TOLUCA	58	136
TONCI TOPIC	14	93
TONSINA	99	178
TOWER BRIDGE	76	
TRONDANGER	3	
TROPIC SUN	10	20
TROPICAL BEAUTY	12	36
TROPICALE	183	218
TRUDY	83	
TULSIDAS	87	
TUVA	53	102
ULTRAMAR	22	
ULTRASEA	11	23
UNAMONTE	32	13
UNI-SPRING	49	197
UNI-SUMMIT	54	99
UNI-SUPERB		10
UNITED HOPE	14	
UNIVERSE	14	
URTE	155	196
USCGC ACACIA (WLB406)	2	
USCGC ACTIVE WMEC 618	3	4
USCGC ACUSHNET WMEC 16		48
USCGC ALERT (WMEC 630)	5	
USCGC BASSWOOD (WLB 38	28	
USCGC BEAR (WEMC 901)	1	
USCGC BISCAYNE BAY	1	3
USCGC BUTTONWOOD WLB 3	33	
USCGC CHEROKEE WMEC 16	132	
USCGC CHILULA (WMEC 15	33	94
USCGC CITRUS (WMEC 300	130	
USCGC CLOVER (WMEC 292	44	
USCGC CONIFIR(WLB 301)	2	3
USCGC DEPENDABLE	14	
USCGC DURABLE (WMEC 62	7	
USCGC EAGLE (WIX 327)	96	
USCGC ESCANABA	14	
USCGC ESCAPE (WMEC 6)	8	
USCGC FIREBUSH WLB 393	13	
USCGC GALLATIN WHEC 72	34	40
USCGC HAMILTON WHEC 71	40	
USCGC HARRIET LANE	7	
USCGC IRONWOOD (WLB 29	65	46
USCGC JARVIS (WHEC 725	45	
USCGC KATMAI BAY	7	25
USCGC MACKINAW	20	173
USCGC MALLOW (WLB 396)	14	
USCGC MESQUITE (WLB 30	4	32
USCGC MIDGETT (WHEC 72	23	1
USCGC MOBIL BAY	3	1
USCGC MORGENTHAU	73	
USCGC NAUSHON	6	8
USCGC NEAH BAY	8	3

Ship Name	radio	mail
USCGC NORTHLAND WMEC 9	18	
USCGC PLANETREE	22	
USCGC POLAR SEA WAGB 1	5	
USCGC POLAR STAR WAGB	253	458
USCGC RELIANCE WMEC 61	8	
USCGC RESOLUTE WMEC 62	2	
USCGC SALVIA (WLB 400)	16	16
USCGC SPENCER	10	
USCGC STEADFAST WMEC 6	16	34
USCGC STORIS (WMEC 38)	18	55
USCGC SUNDEW (WLB 404)	24	
USCGC TAHOMA	5	
USCGC TAMPA WMEC 902		26
USCGC VALIANT (WMEC 62	2	
USCGC YOCONA (WMEC 168	156	238
USNS ALGOL	5	
USNS ALTAIR	4	
USNS APACHE (T-ATF 172	18	47
USNS AUDACIOUS		41
USNS CAPELLA	1	
USNS CATAWABA	9	32
USNS CHAUVENET TAGS 29	2	
USNS DE STEIGUER		209
USNS GUS W. DARNELL	69	94
USNS HARKNESS (T-AGS 3	8	
USNS HENRY J. KAISER		96
USNS JOSHUA HUMPREYS	59	
USNS LYNCH T-AGOR 7	6	
USNS MERCURY	49	121
USNS MISSISSINEWA		42
USNS MOHAWK (T-ATF 170	42	
USNS NARRAGANSETT	27	85
USNS NEOSHO (T-AO 143)	85	152
USNS PASSUMPSIC TAO 10		139
USNS PAWCATUCK TAO-108		63
USNS POWHATAN TATF 166	48	70
USNS RANGE SENTINEL	17	
USNS REDSTONE	11	
USNS SEALIFT ANTARCTIC	6	11
USNS SEALIFT ARABIAN S	50	43
USNS SEALIFT ARCTIC	73	32
USNS SEALIFT CARIBBEAN	28	75
USNS SEALIFT CHINA SEA	22	59
USNS SEALIFT IND'N OCE	22	15
USNS SEALIFT MED	38	104
USNS SIRIUS (T-AFS 8)		119
USNS SPICA (T-AFS 9)		87
USNS VANGUARD TAG 194	95	216
VALLEY FORGE	93	189
VAN HAWK	46	129
VAN TRADER	31	72
VIRGO	33	111
VISHVA PALLAV	18	
VISHVA PANKAJ	2	
VISHVA PAROG	53	
VISHVA PRAFULLA	21	
VISHVA SHAKTI	1	
VISHVA SIDDHI	5	
WASHINGTON HIGHWAY	35	
WASHINGTON RAINBOW #2	32	89
WESTWARD VENTURE	18	29
WESTWOOD ANETTE	125	83
WESTWOOD BELINDA	32	13
WESTWOOD CLEO	93	57
WESTWOOD JAGO	139	120
WESTWOOD MARIANNE	24	128
WESTWOOD MERCHANT	1	
WESTWOOD MERIT	32	67
WESTWOOD MUSKETEER	9	
WHITE ROSE	39	
WILFRED SYKES	103	195
WILLIAM J. DELANCEY	344	379
WILLIAM R. ROESCH	102	186
WINTER MOON	64	
WINTER SUN	19	
WINTER WATER	28	
WOLVERINE	47	82
WORLD WING #2	87	88
YACU WAYO	14	30
YAMATAKA MARU	99	
YANKEE CLIPPER	88	
YORKTOWN SEA	7	5
ZEUS	11	
ZIM GENOVA	23	
ZIM HAIFA	31	
ZIM HONGKONG	59	
ZIM HOUSTON	28	
ZIM IBERIA	72	
ZIM KEELUNG	79	
ZIM MARSEILLES	21	
ZIM MIAMI	35	
ZIM NEW YORK	51	
ZIM SAVANNAH	34	
ZIM TOKYO	48	
YOUNG SCOPE	79	
YOUNG SKIPPER	33	
YOUNG SOLDIER	38	
YOUNG SPROUT	56	67
ZEELANDIA	77	

Summary of U.S. VOS Weather Reports

Grand Total Via Radio – 54,569
Grand Total Via Mail – 58,736
Total Duplicates – 25,873 (29.6%)

Unique Radio Obs. – 28,696 (32.8%)
Unique Mail Obs. – 32,863 (37.6%)
Total Unique Obs. – 87,432

Top Ships

Radio

NOAA Discoverer
Sea Wolf

Mail

NOAA Mt Mitchell
Chevron Sky

July, August and September 1989

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
ARGO	2	2	0	***
A3BE	46	46	0	COLUMBUS CANADA
A3BG	2	2	0	***
A3BZ	74	74	0	ACT 12
A8VI	59	59	0	PACDUCHESS
CBVN	22	22	0	VINA DEL MAR
CGBV	6	0	6	DAWSON
CGBY	51	0	51	***
CG2683	23	23	0	ALFRED NEEDLER
C7C	213	1	212	OCEAN STATION CHARLIE
C7L	52	51	1	OCEAN STATION LIMA
DAKE	105	105	0	KOELN ATLANTIC
DA9100	240	240	0	***
DBLK	77	77	0	POLARSTERN
DGLM	31	31	0	MONTE ROSA
DGVK	61	61	0	COLUMBUS VICTORIA
DGZV	48	48	0	COLUMBUS VIRGINIA
DHCW	91	91	0	COLUMBUS WELLINGTON
DHJW	115	115	0	ACT 9
DHOU	16	16	0	PURITAN
DLEZ	31	31	0	YANKEE CLIPPER
D5NE	25	25	0	MT CABRITE
D5NZ	106	106	0	POLYNESIA
ELBX3	22	22	0	PACKING
ELDM8	16	16	0	SEAL ISLAND
ELED7	30	30	0	PACPRINCE
ELED8	28	28	0	PACPRINCESS
EREA	92	76	16	MUSSON
EREB	188	162	26	VOLNA
EREC	69	11	58	PRILIV
EREI	118	6	112	OKEAN
ERES	95	64	31	VICTOR BUGAEN
ERET	78	74	4	GEORGE OUSHAKOV
EREU	95	93	2	ERNST KRENKEL
FAQV	2	2	0	***
FNCZ	39	39	0	LIBREVILLE
FNGB	21	21	0	MARION DUFRESNE
FNGS	66	66	0	LAFAYETTE
FNIB	7	7	0	THALASSA
FNJT	11	11	0	KORRIGAN
FNOM	34	34	0	ANGO
FNPA	96	96	0	RONSARD
FNQB	48	48	0	ILE MAURICE
FNQC	59	59	0	VILLE DE ROUEN
FNQM	28	28	0	VILLE DE MARSEILLE
FNZO	10	10	0	RABELAIS
FNZP	28	28	0	RACINE
FNZQ	95	95	0	RIMBAUD
FPID	7	7	0	ROSPICO
FPYO	6	6	0	CAP SAINT PAUL
FWQP	35	35	0	A. NIZERY
FZVN	132	132	0	SUROIT
GACA	12	12	0	***
GLNE	17	17	0	DISCOVERY
GNAM	13	13	0	CIROLANA
GOVL	1	1	0	ACT 4
GOVN	55	55	0	ACT 6
GPHH	4	4	0	FARNELLA
GQEK	23	23	0	***
GTIA	10	10	0	***
GYRW	36	36	0	ENCOUNTER BAY
GYSA	45	45	0	FLINDERS BAY
GYSE	25	25	0	NEDLLOYD TASMAN
GZKA	9	9	0	ACT 3
HO4667	17	17	0	***
HPAN	48	48	0	MICRONESIAN COMMERCE
HPEW	79	79	0	PACIFIC ISLANDER
HPKS	3	3	0	***
H9BQ	1	1	0	MICRONESIAN INDEPENDANCE
IGMA	4	4	0	***
JBOA	39	39	0	KEIFU MARU
JBRR	48	48	0	JAPAN TUNA II
JCCX	113	113	0	CHOFU MARU
JCDF	7	7	0	SOYO MARU
JCDT	38	38	0	AMERICA MARU
JCIN	56	56	0	TOKYO MARU
JCOD	39	39	0	SHOYO
JDRD	85	85	0	SHOYO MARU
JDWX	70	70	0	***
JFDG	103	103	0	SHUMPU MARU
JG2K	66	66	0	RYOFU MARU
JITV	192	192	0	***
JJ2C	15	15	0	HAKONE MARU
JLTI	4	4	0	***
JPVB	98	98	0	SEIFU MARU
KGSM	13	13	0	***
KGWU	13	13	0	TH. WASHINGTON
KIRH	23	23	0	SEALAND TRADER
KNBD	45	45	0	DELAWARE II
KRGB	66	66	0	SEALAND ENTERPRISE
NAEZ	30	30	0	DE STEIGUER
NAQD	6	6	0	JARVIS
NAVOCE	2	2	0	U.S. NAVAL OCEANOGRAPHIC
NBKW	1	1	0	***
NBMO	45	45	0	MISSOURI
NBTM	45	45	0	POLAR STAR
NCPN	1	1	0	***
NDKB	2	2	0	***
NDWA	64	64	0	MORGENTHAU
NEKF	1	1	0	LYNCH
NFKQ	72	72	0	SEALIFT ARABIAN SEA
NLGF	5	5	0	NORTHLAND
NMEL	4	4	0	***
NQST	58	58	0	SEALIFT ARCTIC
OWEQ2	20	20	0	MCKINNEY MAERSK
OWUO	9	9	0	***
OWUO6	25	25	0	***
OXFB2	28	28	0	LEXA MAERSK
OXMD2	50	50	0	LARS MAERSK
PGDG	69	69	0	NEDLLOYD KINGSTON
PGDS	28	28	0	NEDLLOYD KYOTO
PGDT	37	37	0	NEDLLOYD BALTIMORE
PGDV	21	21	0	NEDLLOYD BANGKOK
PGEH	45	45	0	NEDLLOYD BAHRAIN
PGEM	23	23	0	NEDLLOYD BARCELONA
PGOF	2	2	0	NEDLLOYD KEMBLA
PJYG	45	45	0	OLEANDER
P3RU	15	15	0	WILHELM SCHULTE
SEPI	2	0	2	***
SHIP	609	606	3	***
S6FK	37	37	0	SWAN REEFER
UBNZ	34	34	0	SHULEYKIN AKADEMIK
UEAK	37	0	37	VALERIAN URYVAYEV
UHQS	109	34	75	AKADEMIK KOROLEV
UINF	140	121	19	***
UJFO	129	118	11	MULTANOVSKIY PROF
UMAY	66	7	59	AKADEMIK SHIRSHOV
UMFW	134	134	0	PROF. ZUBOV
UMWZ	1	1	0	MIRNY
UPUI	246	130	116	PROFESSOR VIZE
UQHM	52	1	51	ABAKANLES
UUPB	116	19	97	AKADEMIK N. SHOKALSKIY
UUQR	1	1	0	MOLCHANOV PAVEL PRO
UVMJ	2	2	0	VSEVOLOD BERYOZKIN
UVMM	166	133	33	GAKKEL, YAKOV
UWEC	26	4	22	PROFESSOR KHROMOV
VCBT	4	4	0	CAPE ROGER
VCTF	22	22	0	CAPE BRIER
VC9450	60	60	0	GADUS ATLANTICA
VG2650	61	61	0	ARC. HARVEST
VJBQ	14	14	0	ANRO AUSTRALIA
VKCK	67	67	0	STUART
VKCN	9	9	0	CANBERRA
VKCV	34	34	0	DERWENT
VKDA	65	65	0	DARWIN
VKLC	99	99	0	BRISBANE
VKML	47	47	0	SNIPE
VKMH	30	30	0	TEALE
VKMS	342	342	0	COOK
VLNB	75	75	0	TORRENS
VMAP	30	30	0	AUSTRALIAN PROGRESS
VXN8	16	16	0	AIRCRAFT
WCGN	53	53	0	CHEVRON CALIFORNIA
WECB	15	15	0	MELVILLE
WRA4560	24	24	0	BOLD VENTURE
WRBA	9	9	0	***
WRBB	8	8	0	***
WTDF	14	14	0	T. CROMWELL
WTDK	107	107	0	D.S. JORDAN
WTDM	45	45	0	M.FREEMAN
WTDO	38	38	0	OREGON II
WTEA	49	49	0	DISCOVERER
WTEB	1	1	0	FAIRWEATHER
WTED	79	79	0	CHAPMAN
WTEF	12	12	0	RAINIER
WTEG	6	6	0	MOUNT MITCHELL
WTEJ	175	175	0	MCARTHUR
WTER	184	184	0	M. BALDRIDGE
WTES	14	14	0	SURVEYOR
WTEW	28	28	0	WHITING
WTEZ	4	4	0	FERREL
WXBR	30	30	0	CHEVRON MISSISSIPPI
WXQ7334	3	3	0	PETER ANDERSON
WYR4481	21	21	0	W.J.DELANCY
WZE39	16	16	0	MOANA WAVE
ZCSK	58	58	0	SKEENA
ZCSL	29	29	0	NIMOS
ZMFS	9	9	0	***
3EAB7	6	6	0	CALIFORNIA ZEUS
3EET4	28	28	0	SEAS EIFFEL
3EZG5	10	10	0	HIKAWA II
5MCB	1	1	0	ABERDINE
7JOB	46	46	0	SHINKASHU MARU
7KDD	15	15	0	YOKO MARU
9VBZ	7	7	0	MAHSURI
9VUU	3	3	0	ANRO ASIA

TOTAL BATHYS RECEIVED 8324
TOTAL TESACS RECEIVED 1044
TOTAL REPORTS RECEIVED 9368

July, August and September 1989

Wave-observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the hourly averaging period. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688-2838 for more details.

	STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	JULY		1989											
BUOY	32302	18.0S	085.1W	0706	18.0	19.4	2.4	4.7	23/20	11.2	SE	22.2	02/15	1018.6
	41001	34.9N	072.9W	0260	26.1	27.4	1.3	2.4	07/16	11.0	SW	24.8	07/16	1019.5
	41002	32.2N	075.3W	0600	27.1	27.8	1.4	2.8	14/15	11.8	SW	25.6	20/13	1018.4
	41006	29.3N	077.4W	0741	27.9	28.5	1.1	1.8	05/00	9.2	S	18.6	14/11	1019.1
	41008	30.7N	081.1W	0742	26.5	26.7	0.7	1.5	01/12	8.8	SW	20.0	13/22	1018.1
	41009	28.5N	080.2W	1482	27.0	27.2	0.7	1.4	24/23	7.9	S	24.5	19/23	1019.4
	41010	28.9N	078.5W	1478	27.6	28.2	0.9	1.7	06/02	9.7	S	23.9	18/10	1019.5
	41011	28.2N	080.1W	0339	27.3	27.3	0.8	1.5	24/18	7.8	E	24.7	20/00	1018.6
	42001	25.9N	089.7W	0692	27.9	28.8	0.5	1.8	25/20	9.1	S	34.8	31/00	1016.8
	42002	26.0N	093.5W	0740	27.8	28.8	0.8	3.1	31/09	9.5	S	23.7	23/16	1016.3
	42003	25.9N	085.9W	0738		29.1	0.6	1.8	25/19	6.7	E	21.0	30/22	1017.6
	42007	30.1N	088.8W	0740	27.8	29.2	0.4	1.4	25/18	10.6	SW	34.2	19/00	1017.7
	42015	30.2N	088.2W	0731	27.6	28.3	0.6	2.1	31/23	9.3	SW	25.1	03/15	1017.1
	42016	30.2N	088.1W	0722	27.6	28.4	0.5	1.7	31/23	8.8	SW	22.5	31/19	1016.8
	42017	27.9N	090.9W	0740	28.1	28.7				7.8	SW	29.0	31/21	1016.7
	44004	38.5N	070.6W	0246	24.0	24.3	1.1	3.3	17/12	9.1	SW	26.9	17/09	1018.1
	44005	42.7N	068.6W	0743	17.3	17.0	0.9	2.7	17/23	6.2	N	20.0	17/14	1017.3
	44007	43.5N	070.1W	0733	17.6	15.9	0.5	1.4	10/21	7.3	S	27.2	10/19	1015.9
	44008	40.5N	069.5W	0738	17.1	14.4	0.9	3.6	11/06	9.7	SW	29.1	17/17	1017.5
	44009	38.5N	074.6W	0736	23.7	23.8	0.8	2.3	16/23	9.4	SW	25.6	31/12	1017.6
	44011	41.1N	066.6W	0247	15.8	14.9	1.1	3.8	18/03	6.7	S	20.0	18/00	1017.5
	44013	42.4N	070.8W	0732	19.8	18.2	0.4	2.0	17/20	8.9	SW	26.6	17/16	1016.4
	45001	48.0N	087.7W	0742	6.9	4.0	0.2	0.6	27/21	5.5	SW	15.9	27/04	1018.4
	45002	45.3N	086.4W	0739	17.7	17.1	0.4	1.4	28/05	7.4	S	22.3	28/02	1018.1
	45003	45.3N	082.7W	0065	9.4	5.1	0.2	0.4	01/04	6.2	S	9.5	01/00	1017.4
	45004	47.6N	086.5W	0740	6.6	3.4	0.2	1.0	28/02	5.6	SE	17.7	27/07	1019.2
	45005	41.7N	082.4W	0739	22.6	23.2	0.5	2.2	21/01	7.3	E	22.5	21/00	1017.0
	45006	47.3N	089.9W	0737	10.2	7.1	0.2	0.8	11/21	5.4	NE	17.5	27/04	1018.0
	45007	42.7N	087.1W	0722	20.5	20.1	0.6	2.0	14/00	8.2	N	23.9	19/23	1018.2
	45008	44.3N	082.4W	0735	19.0	18.5	0.4	1.9	28/11	7.3	N	24.5	28/09	1017.7
	46001	56.3N	148.3W	0743	11.3	11.6	1.4	3.7	30/15	10.3	SW	22.7	15/14	1018.5
	46002	42.5N	130.4W	0742	14.8	15.7	1.5	2.9	18/01	10.2	NW	20.9	09/08	1023.2
	46003	51.9N	155.9W	0455	10.2	9.9	1.9	4.5	15/00	13.8	NW	29.0	14/23	1017.0
	46005	46.1N	131.0W	0743	13.7	14.3	1.4	3.1	17/12	9.4	NW	19.6	15/18	1021.2
	46006	40.8N	137.6W	0731	14.9	15.8	1.4	2.9	17/22					1025.8
	46010	46.2N	124.2W	0739	14.9	15.3	1.1	3.7	01/00	9.9	N	28.8	16/15	1020.0
	46011	34.9N	120.9W	0739	13.1	13.4	1.9	3.5	21/08	13.6	NW	28.6	15/00	1015.7
	46012	37.4N	122.7W	0743	12.9	12.9	1.8	3.6	21/04	11.5	NW	24.9	21/03	1017.9
	46013	38.2N	123.3W	0742	11.9	9.9	2.0	4.1	09/09	20.5	NW	32.8	21/03	1015.9
	46014	39.2N	124.0W	0740	12.3	10.9	2.0	4.1	10/00	15.4	NW	32.9	10/03	1017.6
	46022	40.8N	124.5W	0742	13.0	12.2	1.5	3.7	22/09	7.1	N	20.4	09/11	1019.9
	46023	34.3N	120.7W	0733	13.9	14.0	2.2	3.4	14/21	16.9	NW	30.1	15/07	1014.6
	46026	37.8N	122.7W	0738	11.9	12.1	1.5	2.8	09/08	15.0	NW	28.2	14/06	1016.1
	46027	41.8N	124.4W	0733	11.8	10.5	1.4	3.5	22/03	9.2	NW	33.4	09/01	1020.8
	46028	35.8N	121.9W	0740	13.3	12.5	2.3	3.5	21/05	17.8	NW	29.2	15/03	1015.8
	46030	40.4N	124.5W	0742	12.2	10.4	1.5	3.4	22/19	12.0	N	20.8	09/13	1018.9
	46035	57.0N	177.7W	0743	7.8	8.1	1.2	2.8	11/00	11.0	SW	25.1	02/02	1009.3
	46040	44.8N	124.3W	0742	14.9	15.1	1.3	3.2	01/01	10.0	N	24.7	16/16	1020.5
	46041	47.4N	124.5W	0303	14.6	15.2	1.0	1.8	19/05	7.1	NW	22.9	23/02	1019.4
	46042	36.8N	122.4W	0741	13.0	12.6	2.0	3.6	21/08	14.9	NW	25.6	08/01	1017.7
	51001	23.4N	162.3W	0742	25.3	25.8	2.2	3.2	16/18	15.8	E	25.7	23/22	1018.7
	51002	17.2N	157.8W	0671	25.3	26.1	2.4	4.4	19/01	16.2	E	28.1	14/08	1015.3
	51003	19.2N	160.8W	0106	25.9	26.7	2.0	2.5	07/00	12.9	E	19.6	14/09	1016.3
	51004	17.5N	152.6W	0544	25.4	25.9	2.4	4.6	18/13	16.2	E	24.1	13/19	1015.8
C-MAN	ALSN6	40.5N	073.8W	0739	21.9	20.5				9.0	SW	27.0	17/03	1016.7
	BURL1	28.9N	089.4W	0739	27.6					10.8	SW	31.2	31/12	1016.3
	BUZM3	41.4N	071.0W	0734	19.1					12.1	SW	43.6	17/14	1016.6
	CARO3	43.3N	124.4W	0738	14.2					6.7	N	22.6	16/19	1021.0
	CHLV2	36.9N	075.7W	0738	25.1	25.0				10.8	S	30.3	17/00	1018.4
	CLKN7	34.6N	076.5W	0736	26.4					10.0	SW	22.0	05/17	1018.6
	CSBF1	29.7N	085.4W	0734	27.7					7.7	SW	19.5	16/07	1018.0
	DBLN6	42.5N	079.4W	0733	21.5					7.4	SW	36.7	10/15	1018.3
	DESW1	47.7N	124.5W	0732	14.1					9.2	NW	31.0	23/00	1019.8
	DISW3	47.1N	090.7W	0739	17.7					7.0	NE	22.3	11/10	1019.1
	DPIA1	30.3N	088.1W	0738	27.5	29.0				8.3	SW	22.9	02/23	1017.8
	DSLN7	35.2N	075.3W	0682	26.3	26.5	1.0	2.5	17/04	13.4	SW	33.7	18/04	1018.1
	FARP2	8.6N	144.6E	0731	27.8									1010.0
	FBIS1	32.7N	079.9W	0742	27.3					8.7	SW	20.8	19/22	1018.6
	FFIA2	57.3N	133.6W	0739	13.8					5.5	S	25.3	13/21	1018.7
	FPSN7	33.5N	077.6W	0741	26.8					12.1	SW	29.0	08/06	1018.2
	GDIL1	29.3N	090.0W	0729	28.1	29.5				8.8	SW	25.7	23/21	1016.7
	GLLN6	43.9N	076.4W	0727	21.4					8.2	S	25.7	10/18	1017.3
	IOSN3	43.0N	070.6W	0737	19.2					10.1	S	24.4	10/19	1016.8
	LKWF1	26.6N	080.0W	0742	27.4	28.6				6.9	SE	22.0	24/04	1018.3
	MDRM1	44.0N	068.1W	0739	13.9					11.7	SW	31.0	11/00	1015.8
	MISM1	43.8N	068.9W	0743	15.0					10.9	SW	30.0	10/22	1016.1
	MLRF1	25.0N	080.4W	0742	28.1	29.3				9.2	E	24.2	22/13	1018.2
	MPCL1	29.4N	088.6W	0731	27.6					10.6	SW	26.5	04/16	1016.8
	NWPO3	44.6N	124.1W	0739	13.7					6.2	N	26.0	16/19	1020.5
	PILM4	48.2N	088.4W	0739	11.7					8.0	S	24.2	27/01	1019.3
	PTAC1	39.0N	123.7W	0451	11.7					12.7	N	26.4	18/03	1017.8
	PTAT2	27.8N	097.1W	0736	27.5					11.4	SE	23.7	03/03	1015.8

NDBC Station Data Summary

	STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	PTGC1	34.6N	120.7W	0482	12.7					17.0	N	31.6	15/07	1015.9
	ROAM4	47.9N	089.3W	0613	11.9					9.6	SW	26.7	06/04	1020.0
	SAUF1	29.9N	081.3W	0740	26.0	24.9				7.3	SW	19.5	06/21	1019.1
	SBIO1	41.6N	082.8W	0736	23.3					6.4	E	31.3	09/12	1017.4
	SGNW3	43.8N	087.7W	0733	19.7					8.5	N	27.4	09/05	1017.8
	SISW1	48.3N	122.8W	0742	12.9					9.3	W	28.0	01/01	1019.6
	SMKF1	24.6N	081.1W	0730	28.3	29.0				7.4	E	24.5	24/12	1018.8
	SPGF1	26.7N	079.0W	0732	27.9	29.2				4.5	S	19.3	23/17	1019.1
	SRST2	29.7N	094.1W	0712	27.9					10.5	S	25.9	11/02	1017.5
	STDM4	47.2N	087.2W	0739	14.2					9.7	S	28.0	10/11	1018.8
	SVLS1	32.0N	080.7W	0744	27.2	28.7				12.3	SW	27.7	14/01	1019.0
	TPLM2	38.9N	076.4W	0738	24.8	25.6				8.7	S	28.3	16/18	1017.7
	TTIW1	48.4N	124.7W	0738	13.3					7.1	S	27.0	08/04	1020.3
	VENF1	27.1N	082.5W	0741	26.8	30.3				6.1	E	20.4	22/20	1018.1
	WPOW1	47.7N	122.4W	0738	15.1					5.7	NE	18.1	01/12	1018.9
	AUGUST		**1989**											
BUOY	32302	18.0S	085.1W	0717	17.7	18.6	2.6	4.7	03/04	15.0	SE	21.2	07/06	1019.1
	41001	34.9N	073.0W	0738	26.8	27.7	1.3	2.7	07/10	10.6	SW	21.0	18/13	1016.2
	41002	32.2N	075.3W	0573	27.2	28.1	1.2	2.0	06/11	9.4	SW	28.4	08/08	1015.7
	41006	29.3N	077.4W	0736	28.1	28.8	1.1	3.1	20/14	8.2	SE	21.3	21/02	1016.1
	41008	30.7N	081.1W	0741	26.7	27.4	0.8	2.3	21/01	8.6	S	19.6	13/19	1015.8
	41009	28.5N	080.2W	1465	27.7	28.5	0.7	3.0	20/18	7.0	SE	27.0	20/11	1016.6
	41010	28.9N	078.5W	1478	27.9	28.9	1.0	3.5	20/18	8.9	SE	25.3	20/15	1016.7
	41011	28.2N	080.1W	0733	27.8	28.3	0.8	3.0	20/12	7.1	SE	22.3	20/11	1015.4
	42001	25.9N	089.7W	0715	27.9	28.9	0.5	2.1	01/07	7.6	E	26.8	16/14	1014.8
	42002	26.0N	093.5W	0741	28.1	29.2	0.6	2.7	01/00	8.4	SE	20.0	17/19	1014.8
	42003	25.9N	085.9W	0736		29.2	0.5	1.6	01/14	7.4	E	24.9	10/21	1015.2
	42007	30.1N	088.8W	0736	28.0	29.7	0.4	1.7	01/05	9.0	S	37.5	07/05	1016.4
	42015	30.2N	088.2W	0733	27.9	29.2	0.4	2.3	01/01	8.0	SW	19.6	21/20	1015.8
	42016	30.2N	088.1W	0732	27.9	29.2	0.4	2.1	01/00	7.7	SW	20.0	21/20	1015.3
	42017	27.9N	090.9W	0738	28.1	29.0	0.5	3.0	01/13	6.8	E	25.8	01/01	1015.2
	44005	42.7N	068.6W	0735	19.3	18.4	1.1	2.5	05/20	10.8	SW	22.6	25/03	1016.1
	44007	43.5N	070.1W	0739	17.8	16.5	0.7	2.0	08/15	8.0	S	21.4	04/18	1014.4
	44008	40.5N	069.5W	0738	20.0	18.6	1.1	2.6	22/04	9.6	S	22.7	21/20	1016.0
	44009	38.5N	074.6W	0735	23.7	23.8	0.9	2.5	11/03	9.6	S	28.0	11/02	1016.0
	44011	41.1N	066.6W	0244	19.3	18.8	1.4	4.2	07/21	7.3	S	16.2	31/18	1016.2
	44013	42.4N	070.8W	0717	19.5	17.8	0.4	1.1	08/07	9.0	S	20.4	30/23	1015.0
	45001	48.0N	087.7W	0740	11.0	9.2	0.4	1.8	30/06	7.4	SE	18.7	29/21	1014.5
	45002	45.3N	086.4W	0735	18.3	18.8	0.5	1.9	31/22	9.5	SW	25.5	06/11	1015.1
	45003	45.3N	082.7W	0437	17.3	17.9	0.5	1.7	22/21	8.8	NW	20.0	17/05	1016.0
	45004	47.6N	086.5W	0736	9.5	7.0	0.4	2.0	30/04	7.3	S	22.2	29/22	1015.5
	45005	41.7N	082.4W	0739	22.0	23.2	0.5	1.6	07/02	9.1	SW	23.1	22/18	1015.7
	45006	47.3N	089.9W	0733	15.3	14.0	0.4	1.8	30/02	7.6	SW	23.7	06/03	1014.1
	45007	42.7N	087.1W	0728	20.8	21.1	0.5	2.7	06/23	9.0	S	27.8	05/05	1016.7
	45008	44.3N	082.4W	0735	19.2	19.8	0.6	2.1	06/17	8.8	S	23.7	20/17	1015.3
	46001	56.3N	148.3W	0741	13.0	13.5	1.7	4.1	19/04	10.5	SW	23.6	25/05	1015.1
	46002	42.5N	130.4W	0736	16.7	17.6	1.6	2.9	23/03	11.7	NW	19.9	19/15	1022.0
	46003	51.9N	155.9W	0737	11.5	11.2	2.1	4.6	18/06	14.6	SW	27.6	18/01	1014.0
	46005	46.1N	131.0W	0736	15.9	16.6	1.5	2.8	02/04	10.6	NW	19.1	01/23	1021.0
	46006	40.8N	137.6W	0736	17.2	18.0	1.2	2.8	01/00					1026.1
	46010	46.2N	124.2W	0737	15.0	14.9	1.2	2.2	20/14	8.1	N	23.7	18/02	1017.2
	46011	34.9N	120.9W	0736	13.9	14.6	1.4	2.3	24/07	8.7	NW	22.8	01/00	1014.7
	46012	37.4N	122.7W	0739	13.6	13.8	1.4	2.8	15/07	8.6	NW	20.0	24/03	1015.1
	46013	38.2N	123.3W	0294	12.3	11.3	1.3	1.5	01/07	11.9	NW	26.5	13/02	1014.9
	46014	39.2N	124.0W	0737	12.3	11.7	1.8	3.6	16/03	10.2	NW	29.0	15/03	1014.0
	46022	40.8N	124.5W	0735	12.9	12.5	1.7	4.0	17/07	8.2	N	21.1	20/12	1015.8
	46023	34.3N	120.7W	0738	14.6	15.2	1.5	2.4	24/10	13.4	NW	26.2	01/06	1013.6
	46026	37.8N	122.7W	0736	12.9	13.7	1.2	2.0	15/03	9.2	W	23.7	02/00	1014.0
	46027	41.8N	124.4W	0729	11.8	10.7	1.7	3.7	16/23	10.4	N	31.1	16/00	
	46028	35.8N	121.9W	0213	13.8	13.4				9.8	NW	23.6	01/09	1014.7
	46030	40.4N	124.5W	0741	11.9	10.2	1.6	3.2	17/18	11.6	N	22.7	17/09	1014.9
	46035	57.0N	177.7W	0736	9.8	10.1	1.6	4.1	21/11	13.3	W	26.6	04/22	1007.9
	46040	44.8N	124.3W	0740	14.7	14.4	1.4	2.4	01/23	8.5	N	25.3	01/22	1017.5
	46041	47.4N	124.5W	0734	13.7	14.0	1.2	2.3	20/14	6.5	N	18.7	30/03	1017.0
	46042	36.8N	122.4W	0736	13.8	14.4	1.6	2.7	14/20	8.9	NW	22.7	31/00	1015.4
	51001	23.4N	162.3W	0736	25.6	26.7	1.7	2.7	20/14	11.2	SW	20.8	20/06	1016.8
	51002	17.2N	157.8W	0010	25.4	26.6	2.0	2.2	01/00	14.7	E	16.8	02/00	1016.0
	51004	17.5N	152.6W	0240	25.6	26.3	2.0	2.8	12/12	13.2	E	18.8	12/15	1015.2
C-MAN	ALSN6	40.5N	073.8W	0738	22.1	21.4				10.0	SW	25.0	11/16	1014.9
	BURL1	28.9N	089.4W	0741	28.0					7.7	S	27.6	01/07	1014.8
	BUZM3	41.4N	071.0W	0735	20.4					12.7	S	25.3	06/03	1015.1
	CARO3	43.3N	124.4W	0740	13.6					6.7	NE	23.2	01/23	1017.[illegible]
	CHLV2	36.9N	075.7W	0736	24.9	25.1				9.3	NE	25.6	10/15	1016.[illegible]
	CLKN7	34.6N	076.5W	0736	26.1					9.3	SW	26.3	09/17	1016.6
	CSBF1	29.7N	085.4W	0741	27.4					5.6	NE	15.2	04/07	1015.9
	DBLN6	42.5N	079.4W	0739	20.5					9.6	SW	32.6	04/22	1016.7
	DESW1	47.7N	124.5W	0739	13.7					7.7	NW	27.7	07/01	1017.0
	DISW3	47.1N	090.7W	0738	18.4					9.8	SW	25.4	06/02	1015.5
	DPIA1	30.3N	088.1W	0741	27.8	29.9				7.6	S	22.0	22/04	1016.4
	FARP2	8.6N	144.6E	0737	27.9									1009.9
	FBIS1	32.7N	079.9W	0737	26.4					7.2	SE	33.3	24/08	1016.9
	FFIA2	57.3N	133.6W	0738	13.3					5.2	N	19.5	14/04	1017.1
	FPSN7	33.5N	077.6W	0732	26.5					10.8	SW	32.9	02/01	1016.2
	GDIL1	29.3N	090.0W	0740	28.3	30.0				7.2	S	26.1	01/03	1015.4
	GLLN6	43.9N	076.4W	0734	20.7					10.0	S	24.5	16/05	1015.5
	IOSN3	43.0N	070.6W	0737	19.0					11.3	S	31.3	31/19	1015.3
	LKWF1	26.6N	080.0W	0737	28.1	29.4				6.7	SE	26.0	20/08	1015.4
	MDRM1	44.0N	068.1W	0738	14.8					12.5	S	28.0	05/05	1014.5
	MISM1	43.8N	068.9W	0737	15.5					11.8	S	25.0	05/19	1014.7
	MLRF1	25.0N	080.4W	0734	28.5	30.2				7.9	E	26.3	24/03	1015.4
	MPCL1	29.4N	088.6W	0738	28.0					8.1	E	26.0	01/04	1015.2
	NWPO3	44.6N	124.1W	0741	13.2					6.4	N	21.0	01/22	1017.4
	PILM4	48.2N	088.4W	0737	14.3					9.5	SE	29.0	02/07	1015.5
	PTAC1	39.0N	123.7W	0586	12.5					8.4	N	22.5	15/01	1014.6
	PTAT2	27.8N	097.1W	0728	28.0					12.6	SE	24.0	02/05	1014.4
	PTGC1	34.6N	120.7W	0740	13.8					12.3	N	26.3	14/08	1014.6
	ROAM4	47.9N	089.3W	0666	14.7					11.8	SW	33.1	06/02	1014.3
	SAUF1	29.9N	081.3W	0736	26.6	26.7				7.6	W	20.6	18/06	1016.6
	SBIO1	41.6N	082.8W	0735	22.3					8.7	SW	25.6	07/00	1016.2
	SGNW3	43.8N	087.7W	0739	20.2					8.6	W	23.9	20/06	1015.4
	SISW1	48.3N	122.8W	0740	13.0					6.9	W	25.0	07/05	1016.7
	SMKF1	24.6N	081.1W	0587	28.8	29.8				7.6	E	23.9	19/21	1015.8
	SPGF1	26.7N	079.0W	0734	28.3	29.9				4.6	SE	23.1	20/07	1016.1
	SRST2	29.7N	094.1W	0740	27.7					9.2	S	46.9	01/12	1015.8
	STDM4	47.2N	087.2W	0738	15.1					11.8	S	29.0	02/03	1015.3

NDBC Station Data Summary

	STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	SVLS1	32.0N	080.7W	0733	26.6	28.3				10.4	N	27.6	01/19	1017.1
	TPLM2	38.9N	076.4W	0737	23.9	25.1				9.1	S	24.3	11/07	1016.5
	TTIW1	48.4N	124.7W	0739	12.6					7.8	S	23.0	30/11	1017.2
	VENF1	27.1N	082.5W	0740	26.9	30.7				6.0	E	29.0	09/23	1015.3
	WPOW1	47.7N	122.4W	0739	15.2					5.4	N	21.5	21/05	1015.9
	SEPTEMBER		**1989**											
BUOY	32302	18.0S	085.1W	0684	17.4	18.4	2.4	4.0	13/13	13.7	SE	24.1	24/14	1018.3
	41001	34.9N	073.0W	0701	25.9	27.5	2.3	6.0	21/21	13.1	S	24.2	19/05	1018.0
	41002	32.2N	075.3W	0688	25.9	26.6	2.0	8.5	21/19	12.2	E	34.2	21/17	1015.7
	41006	29.3N	077.4W	0150	28.0	29.0	1.3	3.6	06/22	7.8	S	14.7	01/17	1016.5
	41008	30.7N	081.1W	0711	26.3	27.8	1.2	3.3	22/01	10.7	NE	31.9	21/23	1014.7
	41009	28.5N	080.2W	1431	27.7	28.7	1.3	4.8	21/17	8.7	E	24.5	21/18	1015.0
	41010	28.9N	078.5W	1434	27.4	28.5	1.7	6.8	21/16	10.2	SE	35.0	21/17	1015.1
	41011	28.2N	080.1W	0717	27.9	28.7	1.3	3.6	21/16	8.8	E	24.1	21/14	1014.3
	42001	25.9N	089.7W	0716	27.9	29.4	0.8	3.2	24/20	8.7	E	22.9	24/21	1012.3
	42002	26.0N	093.5W	0713	27.8	29.3	0.9	3.4	24/15	11.2	NE	25.1	24/17	1013.3
	42003	25.9N	085.9W	0710		28.7	0.6	2.7	25/03	7.8	E	26.2	25/00	1012.9
	42007	30.1N	088.8W	0715	26.0	28.9	0.5	1.7	05/04	11.7	NE	27.4	28/07	1015.1
	42015	30.2N	088.2W	0714	25.8	28.2	0.5	2.3	25/08	10.2	NE	24.1	24/06	1014.6
	42016	30.2N	088.1W	0708	25.8	28.2	0.4	1.7	25/09	10.1	NE	24.9	24/04	1014.1
	42017	27.9N	090.9W	0275	29.1	29.9	0.5	1.0	05/01	5.5	E	14.6	03/13	1014.1
	44005	42.7N	068.6W	0719	16.9	17.4	1.5	4.2	09/23	10.5	S	29.9	27/08	1020.4
	44007	43.5N	070.1W	0712	15.0	14.8	1.0	3.9	10/01	8.8	S	31.1	23/11	1019.3
	44008	40.5N	069.5W	0718	18.9	20.0	1.7	4.3	23/10	13.0	NE	30.9	23/08	1019.8
	44009	38.5N	074.6W	0717	21.4	22.0	1.4	3.0	19/12	11.9	NE	34.2	23/22	1019.4
	44011	41.1N	066.6W	0236	17.4	17.1	2.0	5.2	09/09	10.4	N	21.2	27/12	1019.5
	44013	42.4N	070.8W	0712	16.9	16.5	0.7	2.4	10/02	9.9	S	31.7	23/07	1019.7
	45001	48.0N	087.7W	0716	11.5	10.5	0.7	3.2	23/04	10.3	SW	30.5	23/03	1016.6
	45002	45.3N	086.4W	0719	15.8	17.3	0.8	3.5	22/23	11.9	SW	33.4	23/01	1018.7
	45003	45.3N	082.7W	0715	15.4	17.0	0.7	3.5	23/05	11.3	S	32.8	23/01	1018.4
	45004	47.6N	086.5W	0531	12.6	11.3	0.5	4.1	22/23	8.7	S	32.1	23/04	1017.3
	45005	41.7N	082.4W	0718	18.3	20.8	0.6	2.3	23/07	10.9	NE	26.0	01/17	1018.8
	45006	47.3N	089.9W	0715	13.0	12.4	0.6	2.5	22/23	10.3	SW	27.8	22/21	1016.8
	45007	42.7N	087.1W	0718	17.6	19.4	0.7	5.6	23/06	10.7	S	34.6	23/01	1020.3
	45008	44.3N	082.4W	0706	16.6	18.2	0.7	4.8	23/05	11.1	S	38.5	23/03	1018.9
	46001	56.3N	148.3W	0717	12.5	13.1	2.4	4.7	02/15	13.9	SW	26.1	01/10	1013.4
	46002	42.5N	130.4W	0717	17.1	17.9	2.0	3.3	17/13	12.7	N	24.3	17/11	1019.3
	46003	51.9N	155.9W	0720	11.7	11.4	2.8	6.3	09/00	16.0	SW	35.9	08/19	1011.2
	46005	46.1N	131.0W	0718	16.4	17.0	1.9	3.1	04/17	11.1	N	19.8	06/13	1020.8
	46006	40.8N	137.7W	0716	17.5	18.5	1.6	3.2	23/21	10.3	N	24.5	25/13	1022.9
	46010	46.2N	124.2W	0716	14.5	13.2	1.4	3.1	05/11	9.4	N	23.9	29/20	1016.1
	46011	34.9N	120.9W	0719	13.9	14.3	1.4	2.3	07/03	10.2	NW	22.3	21/01	1014.1
	46012	37.4N	122.7W	0714	14.1	14.9	1.3	2.5	06/14	7.1	NW	20.6	17/20	1014.9
	46013	38.2N	123.3W	0102	14.4	15.2	1.2	1.5	27/10	5.2	E	14.2	30/22	1015.9
	46014	39.2N	124.0W	0715	12.3	12.6	1.6	3.6	06/15	7.7	NW	26.3	02/03	1013.6
	46022	40.8N	124.5W	0716	11.6	11.7	1.6	4.1	06/08	5.5	N	18.3	06/09	1014.5
	46023	34.3N	120.7W	0717	14.3	14.4	1.5	2.5	07/13	15.4	NW	26.2	12/02	1012.8
	46026	37.8N	122.7W	0304	13.6	15.3	1.2	1.9	06/15	6.0	W	20.6	02/03	1014.4
	46027	41.8N	124.4W	0705	11.0	11.2	1.6	4.0	06/03	8.1	N	32.6	06/00	
	46028	35.8N	121.9W	0054	15.4	15.5	1.6	2.1	30/20	5.3	NW	14.2	30/21	1017.4
	46030	40.4N	124.5W	0715	11.5	11.2	1.5	3.3	06/10	8.8	N	20.4	06/15	1013.8
	46035	57.0N	177.7W	0715	8.7	9.6	2.4	6.4	03/16	17.7	N	38.1	03/14	1002.4
	46040	44.8N	124.3W	0718	12.2	11.5	1.6	3.2	05/16	7.8	N	20.8	28/03	1015.9
	46041	47.4N	124.5W	0718	13.2	13.3	1.3	2.9	05/11	5.7	N	15.9	20/03	1016.6
	46042	36.8N	122.4W	0714	14.1	14.9	1.5	2.7	07/02	7.6	NW	19.6	02/02	1015.1
	51001	23.4N	162.3W	0716	25.7	26.6	1.8	3.2	29/03	11.8	E	19.6	19/01	1016.2
	51002	17.2N	157.8W	0067	26.1	26.7	2.3	2.9	28/21	12.1	E	16.0	28/09	1013.2
	51003	19.2N	160.8W	0693	26.2	27.4	1.8	2.9	03/22	10.6	E	18.9	03/05	1013.8
	51004	17.5N	152.6W	0237	25.6	26.3	2.0	3.0	02/18	13.7	E	20.5	24/18	1014.1
C-MAN	ALSN6	40.5N	073.8W	0718	19.5	20.5				12.8	E	39.1	23/05	1019.0
	BURL1	28.9N	089.4W	0720	26.7					10.8	E	28.3	24/05	1013.1
	BUZM3	41.4N	071.0W	0718	18.1					13.1	SW	36.0	23/07	1019.5
	CARO3	43.3N	124.4W	0720	11.7					5.9	N	20.8	26/00	1016.0
	CHLV2	36.9N	075.7W	0718	22.7	24.1	1.4	3.1	24/04	13.4	NE	37.8	23/23	1019.5
	CLKN7	34.6N	076.5W	0714	24.5					12.8	NE	35.1	22/04	1018.0
	CSBF1	29.7N	085.4W	0719	25.7					6.1	NE	23.3	25/21	1014.5
	DBLN6	42.5N	079.4W	0557	17.7					8.3	NE	41.2	01/20	1020.5
	DESW1	47.7N	124.5W	0720	13.6					6.2	N	26.3	07/01	1016.6
	DISW3	47.1N	090.7W	0716	14.7					10.8	SW	36.3	22/16	1018.2
	DPIA1	30.3N	088.1W	0716	25.4	27.9				10.9	NE	27.8	24/06	1015.2
	DSLN7	35.2N	075.3W	0499	24.2	24.5	2.0	6.2	21/18	15.2	NE	37.0	22/07	1017.9
	FARP2	8.6N	144.6E	0696	28.2					5.2	E	23.2	22/01	1010.2
	FBIS1	32.7N	079.9W	0707	24.7					10.2	E	72.9	22/03	1016.4
	FFIA2	57.3N	133.6W	0718	11.4					8.0	N	32.4	04/06	1017.8
	FPSN7	33.5N	077.6W	0715	25.5					15.2	NE	53.8	22/03	1016.7
	GBCL1	27.8N	093.1W	0670	26.4	29.4				12.6	NE	33.9	24/03	1014.2
	GDIL1	29.3N	090.0W	0714	26.3	28.2				9.9	N	25.7	24/05	1014.0
	GLLN6	43.9N	076.4W	0716	17.0					10.8	S	34.5	23/09	1019.5
	IOSN3	43.0N	070.6W	0718	15.9					11.5	S	36.4	23/22	1020.1
	LKWF1	26.6N	080.0W	0718	28.1	29.2				8.0	E	19.0	30/16	1013.6
	MDRM1	44.0N	068.1W	0715	13.5					12.1	S	36.1	23/12	1019.3
	MISM1	43.8N	068.9W	0717	13.9					12.1	S	35.1	02/07	1019.5
	MLRF1	25.0N	080.4W	0715	28.4	30.0				9.2	E	26.3	28/16	1013.5
	MPCL1	29.4N	088.6W	0720	26.7					10.4	E	31.1	28/14	1013.6
	NWPO3	44.6N	124.1W	0719	11.9					6.4	N	23.0	20/00	1015.8
	PILM4	48.2N	088.4W	0717	12.7					13.8	SW	43.5	22/19	1017.5
	PTAC1	39.0N	123.7W	0448	12.0					6.2	N	18.4	07/10	1014.6
	PTAT2	27.8N	097.1W	0715	26.2					11.6	SE	24.2	24/00	1014.9
	PTGC1	34.6N	120.7W	0719	13.4					16.2	N	28.6	22/10	1013.9
	ROAM4	47.9N	089.3W	0682	12.0					14.8	SW	41.0	22/21	1016.8
	SAUF1	29.9N	081.3W	0719	26.2	28.6				9.2	NE	27.6	19/21	1015.4
	SBIO1	41.6N	082.8W	0719	18.3					9.0	NE	36.3	23/05	1017.8
	SGNW3	43.8N	087.7W	0718	15.4					9.0	S	37.2	23/01	1019.4
	SISW1	48.3N	122.8W	0719	13.2					5.0	W	21.0	30/05	1017.2
	SMKF1	24.6N	081.1W	0592	28.7	29.7				9.8	E	27.1	27/21	1014.1
	SPGF1	26.7N	079.0W	0709	28.2	29.7				6.0	SE	20.5	21/15	1014.3
	SRST2	29.7N	094.1W	0707	24.8					8.9	N	24.4	04/01	1015.8
	STDM4	47.2N	087.2W	0718	13.6					14.1	S	43.1	22/23	1018.0
	SVLS1	32.0N	080.7W	0716	25.0	27.3				14.1	NE	50.4	22/04	1015.8
	TPLM2	38.9N	076.4W	0713	21.2	23.4				10.6	NE	33.1	22/19	1019.9
	TTIW1	48.4N	124.7W	0718	13.0					10.1	NE	33.1	28/12	1017.1
	VENF1	27.1N	082.5W	0719	26.2	29.8				6.3	E	23.6	03/17	1013.6
	WPOW1	47.7N	122.4W	0696	14.7					5.5	NE	17.4	25/23	1016.2

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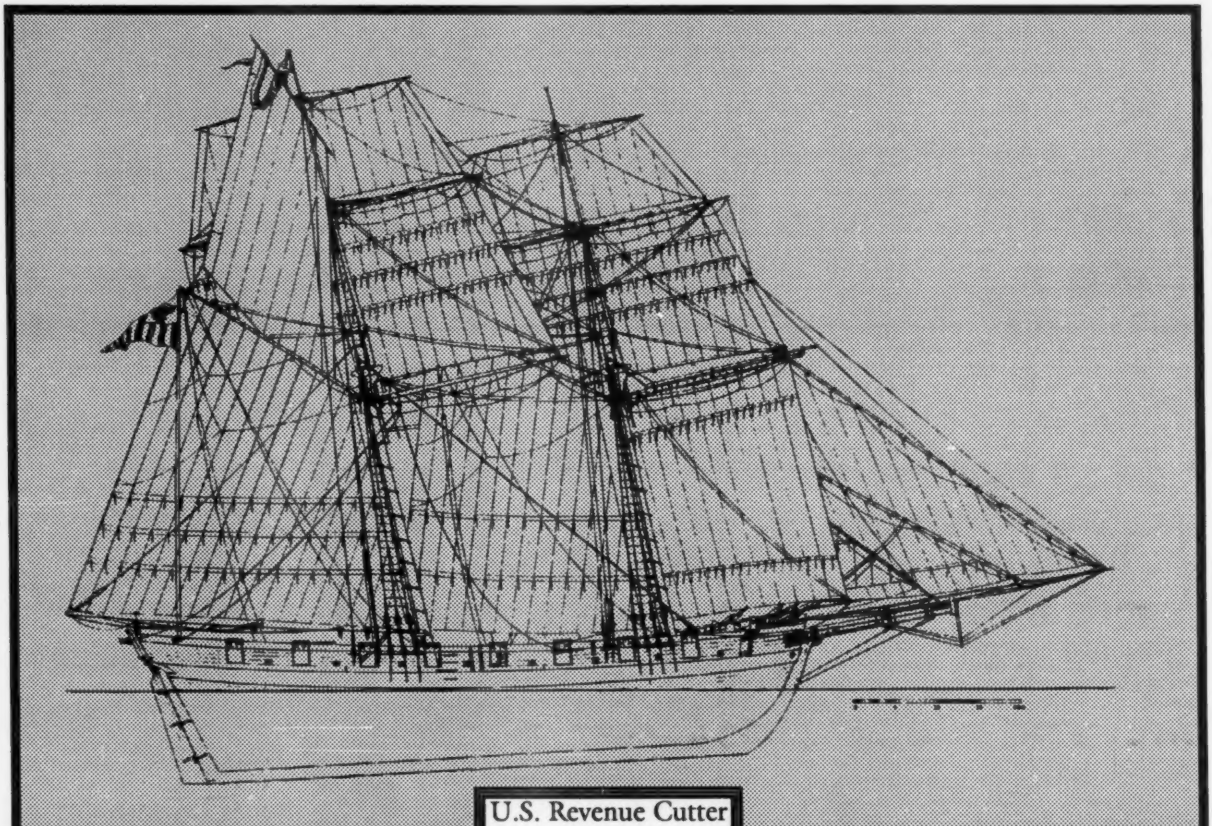

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